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JANUARY, 1830.

Experiments on the Friction and Abrasion of the Surfaces of Solids.

By George Rennie, Esq. F. R. S.

From the Transactions of the Royal Society.

Continued from page 396, *Vol. IV.*

The apparatus referred to, page 388 of the last volume, for performing the experiments on the friction of attrition in solids, is shown in the subjoined cut, Fig. 1, in which *a* is the platform, *b* the fixed scale, and *c* the moving scale.

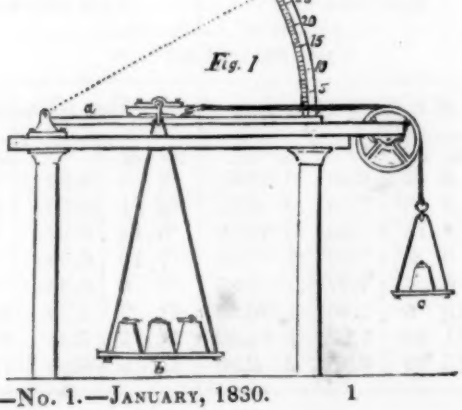

Fig. 1

The apparatus represented, in Fig. 2, was constructed both for brass and iron. The pivots were accurately turned, and the suspending slings loosely hung. The total space passed over did not exceed four inches and a half. The cord was of the best sash-line, and the pulley very sensible. The rigidity of the former and friction of the latter were accurately ascertained, by trials at different weights. The block was of cast-iron accurately bored. The axle was allowed to have full play, in the block, in order that no binding might take place. The space passed through was denoted by marks on the axle and block. The time by a seconds watch.

An improvement was afterwards made in the apparatus by substituting a roller of cast-iron working in a block, and having a cord wound round its surface so as to allow of a descent of the moveable weight of 21 feet.

d, cast-iron blocks.
e, fixed scale.
f, moving scale.

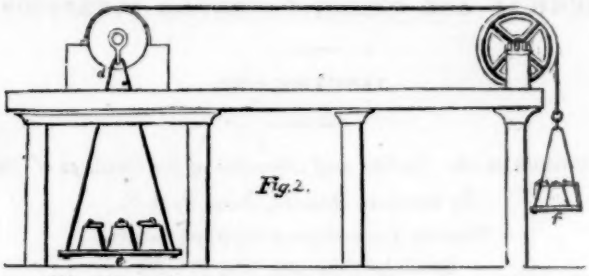

Fig. 2.

TABLE VI. *Experiments on extent of surface with metals.*

Weight to be moved.	Weight required to move it.	Proportion.	Weight to 1 inch of area.	Weight required to move it.	Proportion.	Weight to 1 inch of area.
	Laid flat.			Laid edgewise.		
	Cast Iron on Cast Iron.					
	Area of surface 44 inches.			Area $6\frac{3}{4}$ inches.		
lbs.	lbs. oz.		lbs. oz.	lbs. oz.		lbs. oz.
14	2 2	6.58	0 5.09	2 4	6.20	2 1.1
24	3 3	7.53	0 8.72	3 11	6.50	3 8.8
36	4 14	7.38	0 13.10	5 14	6.12	5 5.3
48	6 8	7.38	1 1.40	7 10	6.30	7 1.7
60	8 4	7.27	1 5.80	9 8	6.30	8 14.2
72	10 0	7.20	1 10.20	11 7	6.29	10 10.6
84	11 10	7.23	1 14.50	13 5	6.31	12 7.1
96	13 12	6.98	2 2.90	15 5	6.27	14 3.5

Experiments on the Friction of different Metals with the weights increased from 14lbs. to 192.

Weight to be moved.	Wt. required to move it.	Proportion.	Weight to 1 inch of area.
Tin sliding on Tin. Area 5.9.			
lbs.	lbs. oz.		lbs. oz.
14	3 10	3.86	2 5.9
24	7 8	3.20	4 1.0
36	9 8	3.78	6 1.6
48	12 13	3.74	8 2.1
60	17 7	3.44	10 2.7
72	22 2	3.25	12 3.2
84	28 8	2.94	14 3.7
96	36 0	2.66	16 4.3
192	66 8	2.88	32 8.0
Soft Steel on Soft Steel. Area 5.9.			
lbs.	lbs. oz.		lbs. oz.
14	2 0	7.00	2 5.9
24	3 7	6.98	4 1.0
36	5 4	6.85	6 1.6
48	6 13	7.04	8 2.1
60	8 11	6.90	10 2.7
72	10 5	6.98	12 3.2
84	12 2	6.92	14 3.7
96	13 12	6.98	16 4.3
192	31 8	6.09	32 8.0
Cast Iron on Hard Brass. Area 7.75.			
lbs.	lbs. oz.		lbs. oz.
14	1 11	8.29	1 12.9
24	4 0	6.00	3 1.5
36	6 0	6.00	4 10.3
48	7 13	6.14	6 3.0
60	9 0	6.66	7 11.8
72	11 0	6.54	9 4.6
84	13 2	6.40	10 13.4
96	14 8	6.62	12 6.1

Experiments on the Friction of different Metals with the weights increased from 14lbs. to 192.

Weight to be moved.	Wt. required to move it.	Proportion.	Weight to 1 inch of area.
Wrought Iron on Wrought Iron. Area 5.9.			
lbs.	lbs. oz.		lbs. oz.
14	2 1	6.78	2 5.9
24	3 13	6.29	4 1.0
36	5 12	6.26	6 1.6
48	7 2	6.73	8 2.1
60	9 8	6.31	10 2.7
72	11 6	6.32	12 3.2
84	12 15	6.49	14 3.7
96	14 3	6.76	16 4.3
192	27 0	7.11	32 8.0
Brass on Cast Iron. Area 6.75.			
lbs.	lbs. oz.		lbs. oz.
14	2 1	6.78	2 1.2
24	3 8	6.85	3 8.9
36	5 1	7.11	5 5.3
48	6 10	7.24	7 1.7
60	9 3	6.53	8 14.2
72	10 5	6.98	10 10.6
84	13 12	6.10	12 7.1
96	15 1	6.37	14 3.5
Tin sliding on Wrought Iron. Area 5.9.			
lbs.	lbs. oz.		lbs. oz.
14	2 10	5.33	2 5.9
24	4 6	5.48	4 1.0
36	6 8	5.53	6 1.6
48	7 14	6.09	8 2.1
60	9 13	6.11	10 2.7
72	11 13	6.09	12 3.2
84	13 15	6.02	14 3.7
96	15 13	6.07	16 4.3
192	32 8	5.90	32 8.0

Experiments on the Friction of different Metals with the weights increased from 14lbs. to 192.

Weight to be moved.	Wt. required to move it.	Proportion.	Weight to 1 inch of area.
Tin sliding on Cast Iron. Area 6.75.			
lbs.	lbs. oz.		lbs. oz.
14	2 12	5.09	2 1.2
24	4 8	5.33	3 8.9
36	6 7	5.59	5 5.3
48	8 14	5.40	7 1.7
60	9 13	6.11	8 14.2
72	11 13	6.09	10 10.6
84	14 5	5.86	12 7.1
96	16 4	5.90	14 3.5

TABLE VIII.—*A Table showing the Power required to move a weight progressively increased until the metals abrade each other.*

Weight to be moved.	Wt. required to move it.	Proportion.	Weight to 1 inch of area.
Wrought Iron on Wrought Iron. Area 6 inches.			
cwt.	cwt. qrs.		cwt.
10	2 2	4.00	1.66
12	3 1	3.69	2.00
14	4 0	3.50	2.33
16	4 3	3.36	2.66
18	5 2.5	3.20	3.00
20	7 0	2.85	3.33
22	8 1	2.66	3.66
24	9 0	2.66	4.00
26	10 1	2.53	4.33
28	11 1	2.48	4.66
30	12 1	2.44	5.00

A Table showing the Power required to move a weight progressively increased until the Metals abrade each other.

Weight to be moved.	Wt. required to move it.	Proportion.	Weight to 1 inch of area.
Wrought Iron on Cast Iron. Area 6 inches.			
cwt.	cwt. qrs.		cwt.
10	2 3	3.63	1.66
12	3 2	3.42	2.00
14	4 2	3.11	2.33
16	5 1	3.04	2.66
18	6 0	3.00	3.00
20	7 0	2.85	3.33
22	7 3	2.83	3.66
24	8 3	2.74	4.00
26	9 2	2.73	4.33
28	10 1	2.73	4.66
30	11 0	2.72	5.00
32	11 3	2.72	5.33
34	12 2	2.72	5.66
36	13 2	2.66	6.00
38	16 2	2.30	6.33
Steel on Cast Iron. Area 6 inches.			
cwt.	cwt. qrs.		cwt.
10	3 0	3.33	1.66
12	4 0	3.00	2.00
14	4 3	2.94	2.33
16	5 2	2.90	2.66
18	6 1	2.88	3.00
20	7 0	2.85	3.33
22	7 3	2.83	3.66
24	8 2	2.82	4.00
26	9 1	2.81	4.33
28	10 0	2.80	4.66
30	10 3	2.79	5.00
32	11 2	2.78	5.33
34	12 2	2.72	5.66
36	14 2	2.48	6.00

A Table showing the Power required to move a weight progressively increased until the Metals abrade each other.

Weight to be moved.	Wt. required to move it.	Proportion.	Weight to 1 inch of area.
	Brass on Cast Iron. Area 6 inches.		
cwt.	cwt. qrs. lbs		cwt.
10	2 1 00	4.44	1.66
12	2 2 14	4.57	2.00
14	3 0 00	4.66	2.33
16	3 1 14	4.74	2.66
18	3 3 14	4.64	3.00
20	4 0 14	4.84	3.33
22	4 2 00	4.88	3.66
24	5 0 00	4.80	4.00
26	5 3 00	4.52	4.33
28	6 1 00	4.48	4.66
30	7 0 00	4.28	5.00
32	7 2 00	4.26	5.33
34	8 0 00	4.25	5.66
36	8 1 14	4.29	6.00
38	8 3 14	4.28	6.33
40	9 1 14	4.26	6.66
42	9 3 00	4.30	7.00
44	12 0 00	3.66	7.33

Appendix to Tables VII and VIII.

Table showing the comparative amount of Friction of different Metals under an average pressure of from 54.25 lbs. to 69.55 lbs. as calculated from the foregoing experiments.

Description of Metals.	Average weight.	Proportion.	Weight per sq. inch area.
	lbs.		lbs. oz.
Brass on wrought iron.....	69.55	7.312	11 12.4
Steel upon steel.....	69.55	6.860	11 12.5
Brass upon cast iron.....	54.25	6.745	8 0.5
Brass upon steel.....	69.55	6.592	11 12.5
Hard brass upon cast iron.....	54.25	6.581	6 15.9
Wrought iron on wrought iron....	69.55	6.561	11 12.5
Cast iron upon cast iron.....	54.25	6.475	8 0.5
Cast iron upon steel.....	69.55	6.393	11 12.5
Cast iron upon wrought iron.....	69.55	6.023	11 12.5
Tin upon wrought iron.....	69.55	5.846	11 12.5
Brass upon brass.....	69.55	5.764	11 12.5
Tin upon cast iron.....	54.25	5.671	8 0.5
Steel upon wrought iron.....	69.55	5.198	11 12.4
Tin upon tin.....	69.55	3.305	11 12.5

Remarks on TABLES VII. and VIII.

1. From the preceding experiments it appears, that the friction of metals varies with their hardness.

2. That the hard metals have less friction than the soft ones.

3. That without unguents, and within the limits of 32 lbs. 8 oz. per square inch, the friction of hard metals against hard metals may very generally be estimated at about one-sixth of the pressure.

4. That within the limits of their abrasion the friction of metals is nearly alike.

5. That from 1.66 cwt. per square inch to upwards of 6 cwt. per square inch, the resistance increases in a very considerable ratio, being the greatest with steel on cast-iron, and the least with brass on wrought iron, their limits being as 30, 36, 38, and 44 cwt. An experiment was made with a weight of 10 tons per inch on hardened steel, which abraded.

The remarkable property of steel in hardening, and its power to resist abrasion, render it preferable to every other substance yet discovered in reducing the friction of delicate instruments, as is exemplified in the different experiments on the pendulum, and the assay and other balances recently introduced at his majesty's Mint and the Bank of England.

The experiments of Messrs. Cavendish and Hatchett in the years 1798 and 1801, at his majesty's Mint, on the alloys, specific gravity, and comparative wear of gold coin by friction, likewise prove that friction and abrasion were less in the hard than soft metals. Philosophical Transactions for 1803. Part I.

[TO BE CONTINUED.]

ENGLISH PATENTS.

To JOHN APPLEGARTH, *Printer, for improvements in Block Printing.*
Dated January 26, 1828.

THE improvements for which this patent has been granted, are produced by an apparatus, which will facilitate the accurate arrangement of the square blocks employed in calico printing, when used successively for the continuation of a given pattern. This apparatus is composed of two principal divisions, the first being of the nature of a table or stand, on which the calico, or other stuff required to be printed, is to be laid to receive the impression of the blocks; and the second consisting of a frame, that fulfils the chief purpose of the object of the patent.

The table, or stand, is made of horizontal stone slabs, a little exceeding the breadth of the stuff, and of the same length, (as represented in the drawing belonging to the specification,) being intended for printing handkerchiefs, or shawls. These slabs are placed successively in one line, within about an inch of each other, on parallel brick walls, of between two and three feet in height, and over them a thick piece of blanket, or other proper woollen stuff is laid, which

is either nailed to pieces of wood fixed beneath the intervals between the stone slabs, or is kept down by metal rods placed across in the same intervals, and passed through staples secured to the walls at each of their ends. A frame is then prepared to lay over this table, containing as many square compartments as there are slabs, which is fastened at one side of the table to hinges, that project from each of the supporting walls for that purpose, which allow the frame either to lie horizontally in close contact with the slabs, or to be raised up vertically, when the calico or other stuff is being laid on the slabs, or removed from them. At one extremity of this table of slabs a row of tenter hooks is placed across, to which one end of the piece to be printed is fixed, and it is then laid evenly over the slabs, and fastened down in the intervals between them by the rods passed through the staples before mentioned, after its farther end is drawn tight by means of a cross bar of wood, to which it is attached by a similar row of tenter hooks, that is either fastened to the other end of the table by cords, or is drawn towards that end by weights attached to the extremities of the same cords.

Supposing the calico, or other stuff, to be properly arranged, and fastened down evenly over the table of slabs, and the frame to be let down horizontally in contact with its surface, a block is then to be taken, having a fourth of the area of one of the square compartments of the frame, on which the pattern preferred has been cut, so that the joinings of the figure may fit accurately, on shifting its position; and the colour having been applied to its face, either by dipping it on the colour-sieve, or by colour-rollers, it is then to be pressed down by a blow or other means, in one corner of the first square compartment of the frame, then in the next corner, and so on successively through the other remaining corners; care being taken to keep the proper angle of the block next the corners of the compartment; one handkerchief or shawl being thus stamped, the same process is to be repeated in all the other compartments of the frame, until the whole piece is completed.

When a medallion, or other central figure, is to be impressed on the middle of the handkerchief, or shawl, then a moveable frame is to be formed of four pieces of wood, of the length of one of the compartments, crossed so over each other (by dividing the joinings) as, when laid in the compartment, to divide its area into nine equal squares; in the central square of these, a block, having the whole of the intended medallion, or other figure, cut on its face, is then to be stamped in the manner before described; or a block having a quarter of the same figure cut on it, (and of course of only a fourth of the area of the central square,) may be used; and the impression be made of the whole figure by four successive operations, in the same way as with the larger blocks in the process first recited.

When only a border is to be stamped on a shawl or handkerchief, the patentee directs that a block of another shape be used; which is to be of the breadth of the intended border, and of such a length as to extend from one angle of the square compartment of the guiding frame to within a distance equal to its breadth of the adjoining angle;

and the pattern proper for the angle of the border, having been cut at the end of the block, placed in the first instance close to the angle of the square compartment; at the next transfer, that end of the block is to be laid in the space left at the extremity of the first impression, where it will form the second angle of the border, and the block being applied successively at the other sides of the compartment in the same manner, will at the fourth impression complete the border.

Obs.—It appears to us, that the improvements of the patentee would very much facilitate and accelerate the operation of block printing, besides increasing the accuracy with which the joinings of the impressions would unite so as to form a perfect uniform design, or pattern: but on the other hand we understand that the process of printing piece goods by rollers, both engraved, and cut so as to act like blocks, has been brought to such perfection, and so much excels in rapidity of execution and precision, any thing that can be done by the manual application of blocks, as to leave the patentee but small chance of superiority in the competition with a rival of so much power and excellence. [*Rep. Pat. Inven.*

To Jonathan Brownill, *Cutler, for an improved method of Transferring Vessels from a Higher to a Lower Level, or from a Lower to a Higher Level, on Canals; and also for the more conveniently raising or lowering of weights, carriages, or goods on rail-roads, and for other purposes.* Dated 1st May, 1828.

In the method of passing boats from one level of a canal to another, proposed by the patentee, the upper level is made to approach close to the vertical line over the end of the lower level, by banks properly constructed and faced with masonry, which advance somewhat more than the length of a canal boat, at each side of the lower level, at the same height as on the upper level, where the masonry forms walls at both sides, similar to those of a canal lock. A water tight caisson is then prepared sufficiently longer than the boat to receive it within its bounds, and a vertical paddle or sluice, running in grooves, is formed at its two ends, which two paddles, when let down, enclose the boat and the body of water in which it floats, so as to retain the latter without leakage; strong frame work is then erected on the two walls at each side of the end of the lower level, on which the axles of large vertical grooved wheels are supported parallel to the canal, so that the edges of the wheels may project at both sides some distance beyond the banks; which in that part are either made entirely of masonry, or at least very nearly so, to enable them to have sufficient strength to support the loads they have to bear, without being broader than is absolutely necessary for this purpose; two at least of the grooved wheels must be placed as mentioned on each of these walls, and over them *ropes* are to be passed

from the caisson that holds the boat, to two other caissons, of about the same length, but of only about half its breadth, which are solely to hold water sufficient to balance that in the former; these two small caissons are to be sustained by the ropes, at the top near the wheels, when the large caisson is in the lower canal; and, on the contrary, when the large caisson is at the top opposite to the upper level, they will then lie at their lowest depth, descending at the opposite sides of the vertical banks as the former becomes elevated.

Paddles or sluices are fixed across in grooves, similar to those in the large caisson, at the termination of the upper level of the canal, and at the end of the lower level, close to the entrance of the space between the banks, and when the caisson is brought opposite to either of them, its end is pressed so close to it, (by means that will be described,) that the space between them will retain water; and a small paddle being first raised in the large paddle of the canal to let the water into this intervening space, the two large paddles of the great caisson and of the canal level next adjoining are then elevated, and the boat is either passed from the caisson into the level, or from the latter into the former, as the occasion may require.

To prevent the counterpoising smaller caissons from descending irregularly, on the axles of the large grooved wheels, a very large toothed wheel is directed to be fixed at each side, of sufficient size to enable the two to meet over the middle of the intervening canal, and interlock with each other, so as to make the axles at the different sides turn round simultaneously in opposite directions; the patentee adds afterwards, that the same effect may be produced by other arrangements of intermediate wheels, if that mentioned should appear objectionable.

In the disposition of the apparatus that has been described, provision is only made for the equilibrium of the counterbalancing smaller caissons with the large one that is to receive the boat: but to cause either of the weights, thus equipoised, to descend, for the above purposes, something more is necessary; this requisite, the patentee asserts, will be obtained by constructing the large caisson with a "false bottom," so as to divide it horizontally into two compartments, the upper one of which will act as has been stated, while the lower one is used as an additional balancing vessel, by pouring water into which, the large boat caisson over it may be made to preponderate, when it is desired that the boat should pass from the upper to the lower level; and on the contrary, by letting water flow from it, the boat caisson will be made to rise, and convey the boat from the lower to the upper level, when this is necessary, by the preponderance of the smaller counterbalancing caissons, which will then occur.

We now come to the contrivance for pressing the end of the boat-caisson against the frame of the sliding sluices, or paddles, at the ends of the different levels of the canal, before alluded to, which paddles perform the offices of lock gates; for this purpose a balance lever with unequal arms is placed at each end of the boat-caisson, the shorter arm of which is furnished with a friction roller, which the

longer arm by its greater weight causes to rise to a level with the centre of motion, when not counteracted; this latter arm points inwards towards the middle of the caisson, where its end is supported, when at rest, by the short horizontal arm of a bent lever, the longer arm of which rises vertically along the side of the caisson, so as to come conveniently within reach of the person who conducts the operation of the apparatus. The shorter arm of the first balance lever will, of course, from what has been stated, project outwards from the end of the boat, where its roller will come in contact with the slope of a double vertical inclined plane made at the end of the inclosed space that connects the two levels, opposite to the sluice, against which the caisson is required to be pressed; so that when, for example, the caisson is rising towards the upper level, the roller of the balance lever at the end of it opposite to the upper level will be pressed downwards, as it comes in contact with the lower slope of the double inclined plane, until it has passed the angle where the two slopes meet, when it will again descend to its former level; at which time, as before noticed, the long arm of the balance lever is supported by the horizontal arm of the bent lever; at this crisis some water is to be admitted into the lower compartment of the large boat-caisson, to cause it to descend again a small space; which will make the roller pass down the upper slope of the inclined plane, and press the caisson in the opposite direction against the paddle frame of the upper level, with the whole force of the weight of this caisson, (the long arm of the balance lever being prevented by the means mentioned from descending, so as to yield to the action of the pressure on the short arm.) The method by which the balance lever and its roller, that is placed at the other end of the boat-caisson, operate in pressing this caisson against the paddle frame of the lower level of the canal, is the same as that described; with the exception of the long slope of the inclined plane, that acts on the roller, being uppermost, and of course on the same level with the lower paddle frame and opposite to it, and that, when the pressure is required, water must be let to flow from the lower compartment of the boat-caisson, to make it ascend a short distance, in order to produce the impulse necessary: in both cases padding, or stuffing, is advised to be used between the lines of contact of the boat-caisson and the paddle frames, but no directions are given as to the formation, or peculiar arrangement of this padding. It will be observed that, when the caisson is pressed against the paddle frame of either levels, it is in a manner locked in that position by its own weight; so that some force will be required to remove this tendency, when the caisson is required to pass in the direction contrary to its former movement; but this force is readily supplied by the conductor by means of the long vertical arm of the bent lever; by hauling which he causes its short arm to ascend, that then elevates the long arm of the balance lever, and thereby forces the roller on its short arm past the angle of the double inclined plane. The patentee is aware, that the momentum of the descending caissons, when the apparatus is in action, should be counteracted at the end of each course, but he makes no other pro-

vision against this, than having a basin, or tank, of water, placed under each of the smaller counterbalancing caissons, into which their momentum will cause them to plunge some distance at the termination of their descent, from which depressure the counterbalancing weight will again speedily elevate them: and when the boat-caisson descends, the water in the lower level of the canal, into which it is to enter, will have a similar effect in counteracting its momentum. There is a reservoir placed at each side of the canal to supply water by pipes furnished with cocks, to the under compartment of the boat-caisson, when necessary, which, however, appears to us to be superfluous.

The second object of this patent,—of passing carriages and goods from one level of a rail-road to another—is effected by a water-counterpoise, in a manner similar to the preceding; a platform being prepared on which the carriage is drawn, which is then elevated to a higher level, when this is required, by two cisterns suspended by ropes over grooved wheels, supported at each side as before; into these cisterns water is let to run from higher reservoirs, until the weight of the whole is sufficient to counterbalance that of the platform, and of the carriage with its load placed on its surface; when, on the contrary, the carriage is to be brought down from the higher to the lower level, after it is drawn on the platform, previously raised up for that purpose, water is let out of the counterbalancing cisterns until the platform and its load preponderate. To this latter apparatus a contrivance is added for economising the water of the reservoir, which consists in placing three reservoirs, at different elevations, near the upper level of the rail-road, all of which communicate by pipes furnished with cocks, with a horizontal tube, that runs across from one system of reservoirs to the other. When the platform, with the carriage, is to be raised, water is first ejected from the two upper reservoirs into the two counterbalancing cisterns; the cocks of the former are then to be opened, until the level of the water within them becomes equal, and are to be then again closed; after this, water is admitted into the descending cisterns from the second two reservoirs; and again from the lowest pair in their turn, when the cisterns come down to their level. And when the platform is to descend, the water is to be let to run out of the counterbalancing cistern, first into the lower pair of reservoirs, next into the middle pair, and lastly, into the upper pair, as the cisterns ascend successively to their levels; the same management of the cocks belonging to their pipes of communication being observed on this occasion, as in the former instance.

The patentee finally observes, that an apparatus on the same principle as the last, may be used instead of a crane, for raising goods into warehouses, or taking them out of ships or carts, as well as for many other similar purposes.

Obs.—An apparatus for passing boats from one level of a canal to another, formed on the same principles as that of Mr. Brownill's, was erected in 1809, by Mr. Woodhouse, on the Worcester and Birmingham canal at Tardebig, near Broomsgrove, and was worked

experimentally for some hours every day for nearly a month in 1811. It was reported to perform very well, passing, on an average, nearly 60 boats in six hours, one-half loaded with from 15 to 20 tons, and the other half empty: and it was thought, that had the tunnel of Tardebig been completed in time, this ingenious engine would have been employed permanently; but as the canal company were obliged to use a steam engine to fill their summit level until the tunnel was completed, which superseded the use of the machine for that time, and for other reasons that were never explained satisfactorily by them, the machine was never used by the company in the transfer of goods.

The particulars in which the present patent apparatus differs from that of Mr. Woodhouse, consist in the employment of caissons of water in place of a mass of bricks, as a counterpoise to the boat and its load, and in using two sets of grooved wheels, one at each side of the canal, instead of the single set employed at one side at Tardebig: but the large caisson that held the boat, and the mode of passing the latter into it, and out of it, from and to the different levels, was the same as that which the present patentee proposes to use, as well as the counterbalancing principle on which the engine was worked.

Mr. Woodhouse used a contrivance for compensating the increased weight, caused, at the different sides of the apparatus, in the ascent and descent of the boat, by the connecting chains increasing in length at the descending side; but the present patentee has nothing of this nature in his engine; nor does he employ any means to prevent the accelerated velocity of the preponderating weights when put in motion; and it appears to us, that his manner of finally disposing of this velocity, by letting the caissons souse down into water, is a very rude and inadequate method. We also think, that his using ropes for connecting the caissons, at the different sides of the grooved wheels, is very objectionable, as the changes of the weather would be perpetually altering their length; which would produce serious inconvenience, and cause them to be neither so durable or so cheap, ultimately, by many degrees, as the chains used for the same purpose by Mr. Woodhouse.

We have already mentioned that we consider the reservoirs, for filling with water the under compartment of the boat-caisson, to be superfluous, and our reason for this is, that the upper level of the canal might be made to serve the same purpose, unless such extreme economy of water were thought necessary on this occasion, as is proposed for the rail-road transferrer. We have, however, less hesitation in thinking the compartment (or, in fact, the fourth caisson) under the boat-caisson, to be unnecessary, since it is very evident that the same effect might be produced without it, by increasing or diminishing the water in the counterbalancing caissons, as might be required for their ascent or descent.

We can say nothing in favour of the application of a water counterpoise for transferring carriages, on the different levels of rail-roads, as we imagine that it would be attended with much needless ex-

pense and complication for an operation, that may be performed much better by inclined planes and *dry* machinery. A water counterpoise may, however, we think, be used to advantage instead of a crane, as proposed by the patentee, though his method is far from being the best for the purpose. [*Ib.*

To JOHN HAGUE, *Engineer, for his having invented certain improvements in the method of expelling the Molasses or Sirop from Sugar.* Enrolled December, 1828.

THERE are two modes proposed by the patentee of extracting the molasses or sirop from sugar; the one is by producing a vacuum or exhaustion of the air under the sugar, by which the weight of the air above will be enabled to cause the liquid part to precipitate through, and leave the sugar dry; the other is by condensing the air above the sugar, and by its mechanical force producing the same effect.

Various forms and constructions of apparatus may be applied to this purpose, and the patentee, therefore, does not confine himself to any one in particular, the improvement consisting in the employment of a false bottom to the pan or vessel in which the sugar is to be operated upon.

This false bottom is to be made of copper, with perforations all over it like a colander, and placed a few inches above the real bottom of the vessel; upon the false bottom a straining cloth is to be laid, and the sugar spread a few inches thick upon the cloth.

The lower part of the vessel below the false bottom being air tight, a pipe from an air pump is to be introduced into the vessel under the false bottom, and the pump being put in action by any convenient means, as by a hand lever, or by connexion to a steam engine or water wheel, the air between the false and real bottoms will be drawn out, and a vacuum thereby produced. The pressure of the air above will then cause the molasses to pass through the sugar, and through the straining cloth, and having descended through the perforations to the bottom of the vessel, may from thence be occasionally drawn off by a pipe, with a cock inserted into the bottom of the vessel, leaving the dry sugar above.

It is unnecessary to describe the construction of an air pump, as that is well known, and a vessel of any convenient form with a perforated false bottom will answer the purpose, provided the sugar is so spread as to cover the bottom completely; and the operation will be further promoted by occasionally sprinkling a little water, or water impregnated with lime, upon the upper surface of the sugar.

The upper part of the vessel being closed, an air pump may be employed to force in a quantity of air, which becoming condensed above the surface of the sugar, will force the molasses and other liquid parts through the sugar into the lower vessel, as above described.

Either of these operations may be performed, or both may be brought into action together, and the molasses will by these means

be more effectually extracted from the sugar, than by any other process heretofore employed. [*London Journal.*

To GABRIEL DE SORAS, *Gentleman, and* STACEY WISE *and* CHARLES WISE, *Paper-makers, in consequence of a communication made to them by a certain foreigner residing abroad, for an invention of certain improvements in Sizing, Glazing, and Beautifying the Materials employed in the Manufacture of Paper, Paste-board, Bristol-board, and other substances.* Enrolled February, 1828.

FOR the purpose of sizing paper, it is proposed to employ a fluid compound of alkalies dissolved in water, with bees' wax and alum. The mode of preparing this size, is, by first making a lie of quicklime and alkaline salts, such as pearlash, potash, or carbonate of soda, which are to be dissolved in water in a wooden vessel—deal is to be preferred; the strength of the lie may be known by its specific gravity. It is proposed to use it for the present purpose at 104, distilled water being 100.

Any quantity of this lie being put into a copper boiler, and made hot, add to it as many pounds weight of fine bleached bees' wax as there are pounds of the lie, and boil them well for some hours. But it is considered that steam heat will answer better than fire.

When the wax is properly dissolved and mixed with the lie, introduce four gallons of boiling water for every pound of wax, and let them be well stirred until fully combined. If the wax be not perfectly dissolved before introducing the boiling water, a small additional quantity of alkali should be employed, which will effect the object.

To the fluid thus prepared a quantity of the farina of potatoes is to be added, or potato starch, in the proportion of four pounds of the flour in a dry state to every pound of wax; and this, when properly incorporated and become cold, constitutes a size suited to the purpose under consideration.

The patentee says that he proposes the employment of potatoes, or potato starch, only in consequence of its cheapness, as other farinaceous matter would do equally well; and he states that the potatoes are prepared by boiling and bruising them, and after straining the farina from the skins and fibrous matters (which are thrown away,) the water is evaporated, and the flour dried in any convenient manner.

The size formed as above, is to be mixed with the rags which constitute the pulp in the vat, in the way that size is commonly introduced, when the paper is not intended to be sized in sheets, and with it is to be used a quantity of alum dissolved in the water and size contained in the vat. The proportions of alum to the other materials will depend upon circumstances, which will be known to paper-makers, and, therefore, need not be particularly stated.

Paper thus sized in making, will, when pressed in sheets, assume a glossy and beautiful appearance. The mode of pressing may be

nearly the same as is commonly adopted by paper-makers. Sometimes the patentee presses the sheets between sheets of unsized paper, which has been steeped in a strong solution of alum, and at other times he presses them between felts which have been so steeped. These felts will require to be frequently washed, for the purpose of cleansing them from the size which they may take up by the operation.

The sheets of paper will require to be opened and separated at least twice during the pressing process, and when dried, will be found to possess a beautiful gloss, as above said. [*Ib.*

To WILLIAM POWNALL, *Weaver, for his new invented improvements in making Healds for weaving purposes.* Enrolled July, 1828.

THERE are two methods proposed by the patentee of forming the healds for weaving; the first is by tying the knots of the cords or heald yarns alternately above and below, so as to prevent the knots from obstructing the free passage between the healds; the second is by constructing the healds of cloth, or such material woven in a peculiar way.

The method of forming the first kind of heald is by providing a bench, as many feet in length as the intended heald is to be wide, and of a width equal to the height of the intended heald. Blocks are to be placed at each end of the bench, for the purpose of supporting the two rails of the heald which is about to be formed, and raising them up a few inches, that the hands of the workmen may pass conveniently above and below. A rod is to be placed along the bench, resting upon the blocks, midway between, and parallel to, the two rails.

Two workmen are now to be seated, one on each side of the bench; one passes the heald cord over the rail on his side, and over the rod, and bringing it back to the rail, secures it; the other passes his cord in a similar way over the rail on his side, and through the loop formed by the first cord, then ties the knot to make the cord secure. The second workman then passes a cord from the rail over the rod and back again, and the first workman carries a cord from his rail through the loop, and then makes it fast by a knot. Thus the cords of the heald are alternately tied on the upper and under side of the rod, which is to form the eye. This constitutes the first improvement.

In making the healds of woven cloth, the mode proposed is to weave in a loom, a cloth or material made by shoots of suitable yarn in a warp of a length just sufficient to reach from one headle or heald rail to the other.

In weaving this material, a few inches of strong yarn is first to be shot through the warp, then a finer yarn, and then worsted, which being elastic, is to receive the eye of the heald for guiding the warp thread or yarn when the heald is made and applied. Next to the worsted some shoots of fine yarn are to be placed, and then the strong yarn as before.

The fabric thus made is to be properly stiffened, and then cut into

strips of one-tenth of an inch each, which strips being tied up to the heald rails, constitute the improved heald of the second kind proposed under this patent. [*Ib.*

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN OCTOBER, 1829.

With Remarks and Exemplifications, by the Editor.

1. For a *Machine for Cleaning the Dirt, &c. from Seed Cotton;* James Gilliam, Carrol county, Tennessee, October 10.

A hollow drum, of six feet in length, and 20 inches in diameter, is made to revolve, in the manner of a bolting screen; but with its axis horizontal. Its periphery is formed by slats of wood, extending from end to end, and having a space of about half an inch between them. This drum is contained within a trough, or box, and rests upon friction rollers, upon which it revolves, as it is without gudgeons. A shaft extends through the centre of the drum, and is supported upon gudgeons outside of its heads; four boards are affixed by their edges to the shaft, and extend the whole length of the inside of the drum, forming wings, or leaves, standing at right angles to each other; upon the edges of these wings are placed, obliquely, flat pieces, to serve as conveyers, causing the seed cotton to pass from one end of the drum to the other. The shaft, with its wings, revolves much more rapidly than the drum. The cotton is put into a hopper, and in passing from one end of the drum to the other, is cleaned.

The claim is to "the whole of the above described machine."

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2. For an improvement in the *Manufacturing of Gentlemen's Stocks;* G. R. Lillibridge, New York, October 10.

The foundation, or stiffening part of this stock, is formed of two pieces, joined together lengthwise, say of doubled buckram. They are to be so joined that they move on each other, as on a hinge, and are hence called "Hinge Stocks." When thus formed, they are to be covered and lined in the usual way. The buckram may be rendered water-proof, by shellac varnish. The claim is to "the composition, and manner of forming the hinge, by which the two component parts of the foundation of the stock are united together, by which the same is rendered sufficiently pliable, without the possibility of becoming displaced by ordinary wear."

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3. For an improvement in *Making Combs;* Eli Sperry, New Haven, Connecticut, October 10.

A quilled back comb is to be made of wood, the grain running with the teeth of the comb; a tube of metal, the bore of which exactly fits the back of the comb, is then drawn over it, and cemented or

not, as may be thought best; there must, of course, be an opening along the tube to allow for the thickness of the teeth of the comb. The claim is to "the hollow wire tube."

On the 14th of April, a patent was obtained by Nathaniel Bushnell, of Connecticut, for manufacturing quill backed combs of wood, by making the back and teeth in separate parts, with the grain in each running longitudinally, the part forming the teeth being let into a groove in the back; this appears to us preferable to the plan now proposed.

There is not any drawing accompanying this specification; the patentee may say that it can be perfectly well understood without one; but the law says, "and shall accompany the whole with drawings and written references, whenever the nature of the case admits of drawings."

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4. For an improvement in *River Dams*, for the easy passage up and down of fish, and of vessels; Patrick M'Grath, Philadelphia, Pennsylvania, October 10.

If we understand the description of this improved mode of forming dams, it consists in making the dam, on the descending side, in the form of a plane but little inclined to the horizon, so that the water in passing down shall run with but little velocity. The claim is to "an easier communication between rivers and dams, for fish, vessels, &c."

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5. For an improvement in the *Application of Power to Machinery;* Robert Mitchell, Cynthiana, Harrison county, Kentucky, October 10.

This patent is for one of those outrages upon the A, B, C of mechanics, which might astonish us were they not so frequently perpetrated. The screw of Archimedes is to be made to elevate iron balls of 200 lbs. each, which are to fall upon a bucket wheel, near its top, and be delivered at the bottom into a trough, down which they are to run into the "Elevator." "The power of one horse will run the elevator with twelve balls weighing 2400 lbs.; this weight applied on the side of a wheel 30, or any other convenient number of feet in diameter, may be applied to the running of any kind of machinery," says the patentee, and no doubt he is correct, provided his machinery does not require more than the power of half a horse to turn it.

If power is to be thus gained, why fatigue and feed the horse? a little of this swindled power may as well be applied to the turning of the elevator, and the circulating medium of iron be thus rendered perpetually current.

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6. For a machine called "the Queen Washer," for *Washing of Cloths* and clothing, and scouring the same; Pinkham Mosher, Milton, Saratoga county, New York, October 10.

This *royal* washing machine bears a strong resemblance to some of its cotemporaries, as other royal personages are found strongly to resemble the less elevated of their species. By quoting a part of our notice of the last washing machine mentioned by us, we should furnish a tolerable description of the present. There is a circular segment furnished with rollers; upon these rollers the clothes are to be placed, when they are to be acted upon by rollers placed upon a swing frame, suited to the lower segment. (See the account of Cherry's washing machine, p. 402, of the last number.) We may also quote the concluding remark of that notice, as it applies to the specification of the present patent. "There is no claim either general or particular."

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7. For a *Machine for Sawing Shingles;* Richard M'Omber, Galway, Saratoga county, New York, October 10.

Thirty-five well filled pages of foolscap are occupied with the description of this machine, although the instrument itself is not very complex.

Numerous patents have been obtained for shingle machines, some of which strongly resemble the present, and are in successful operation. A circular saw is driven by a whorl and band; the block from which the shingles are to be sawed is fixed by dogs, or holdfasts; the carriage upon which it is secured is made to traverse backwards and forwards, and a cant is given to the block, to regulate the thick and thin end. The claim is to "the application of springs and cords, in the manner described, to produce the feeding of the shingle block, up to the saw, and the readjustment of the carriage after a shingle is sawed." The peculiar mode in which the gauges are fed which regulate the thickness and shape of the shingles. The mode of drawing back the block piece, &c. of the carriage after the shingle block is sawed up. The mode of ungearing the machine when the shingle block is sawed up. The peculiar construction of the cog wheel by which the carriage is impelled forward until a shingle is sawed, and then permitted to return by the vacancy on said cog wheels.

We have not thought it necessary to attempt a description of these respective parts, because they do not appear to us to possess much either of novelty or of merit in the combination.

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8. For an improvement in the *Rubbing Down and Polishing Combs* by "twin buffs;" Lewis B. Prindle, and David Curtis, Fairfield, Connecticut, October 10.

Instead of using one buff, in the ordinary way, the patentees cause two circular buffs to revolve in reverse directions, with their faces in contact; these buffs are covered with some spongy material, and are charged with pulverized English brick, for rubbing down, and with rotten stone for polishing, or with any substances possessing similar properties. Between these buffs, the backs of the combs to be rubbed down, or polished, are to be held.

It is unnecessary to describe the mode of driving the mandrels upon which the buffs are placed, as any workman can effect this. The novelty for which the patent is taken, is, manifestly, the twin buffs.

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9. For an improvement in *Bilgeways*, called "Frame Bilgeways," for the purpose of drawing out of the water, and relaunching, ships and other vessels; John Thomas, New York, October 10.

The frame bilgeways consist of two longitudinal timbers, with nine cross timbers of solid oak crossing them at right angles, and securely bolted to them; five of these nine pieces project beyond the longitudinal pieces. The patentee says, "it may be proper for me to describe the common bilgeway, which is as follows: the common bilgeways are large square pieces of timber, extending nearly the length of the vessels to which they are applied, one of which timbers is placed on each side underneath the bottom of the vessel intended to be launched, or hauled up, leaving the fore and after part of the vessel unsupported."

"The principle, or character, which distinguishes the improvements I have made in the construction of the Frame Bilgeways for drawing out of the water for repairs and relaunching, ships and other vessels, consists in this: the cross timbers uniting the lengthway timbers at right angles, do thereby compose a frame on which the keel and the bilge of the vessel are always supported, and which constitutes the Frame Bilgeway. On the projecting parts of the long cross timbers will be the support of the sides, and the upper parts of the vessels."

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10. For an *Eight Barrelled Percussion Gun;* Samuel L. Faries, Middletown, Butler county, Ohio, October 10.

We have described several guns for which patents have been obtained, which were provided with a revolving breech, containing four or more chambers to be loaded at one time, and successively brought to coincide with the main barrel, and have spoken of the difficulties attending their employment. The present patentee is more bold than his predecessors, as he proposes to adapt a similar contrivance, not to rifles merely, but also to cannon. He has a revolving breech consisting of eight chambers, united together so as to form radii, each being furnished with its touch hole. This radiating breech turns, with play, on a centre pin, so that each chamber may in succession be brought to coincide with the main barrel, against which it is to be pressed by a screw bearing against the end of its opposite chamber. A percussion lock is to fire the piece.

Should a piece of ordnance of this description be manufactured, we should stand aloof at the time of proving it; for although the cheeks between which the breech is to revolve, and also the end in which the screw works, are to be cast solid with the body of the gun, we

fear that those behind would be in as much danger from the breech, as those before from the ball. A cannon divided transversely, and held together by a screw behind, even supposing no actual fracture to take place, would open the joint every time it was fired, from the power of the recoil, and the vibratory motion experienced by every part of it. The percussion lock for cannon is not that simple thing which answers for small arms; upon this we might offer many remarks, but must defer them for a time. The rifle which Mr. Faries has represented in his drawing, although less objectionable than the great guns, is not, we apprehend, altogether free from the difficulties which have been encountered, but not overcome, by its predecessors.

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11. For a mode of *Raising Vessels out of Water*, called the "Screw Dock;" Elisha Turner, Rochester, New York, October 10.

In the construction of this dock, as represented in the drawing, a slip, or pier, is formed by driving rows of piles; and these inner rows are to be framed and braced to other rows of piles driven at a suitable distance outside of the former. Upon these a second frame is to be constructed of a height sufficient for the raising of a vessel. Through the strong upper timbers of this frame, screws are passed, the heads of which rest upon the frame, their shanks extending down and working into female screws firmly fixed in the tops of vertical sliding pieces. To the lower ends of these sliding pieces are framed beams, or bearers, extending from one side of the dock to the other, the beams thus attached to opposite slides, serve, unitedly, as a cradle to sustain the vessel, which is to be floated in over them, and raised by the screws.

To us, this screw dock appears to be in some points inferior to those formerly patented, particularly in the fixing of the nuts in the tops of the slides, where it will be difficult to secure them so as to sustain the enormous weight which they are intended to bear. Perhaps the patentee may have some superior mode of doing this, but if so, he has not explained it. The drawing gives no aid for understanding the details, as it is very indifferently executed. The inventor says, "I claim as my invention and improvement the above described new method of placing and securing the screws employed for raising vessels by means of two frames placed one on each pier, and by means of posts and slides prepared and placed in the manner above described, so that the screws may be wrought wholly out of water, and be turned by machinery placed upon the frames erected upon the piers."

"The inconveniences experienced from working screws under water are many and great, and by this improvement are avoided, and the screws made to work much more securely, and much easier; and the labourers, and the machinery used to turn the screws, are placed in a much more convenient situation while employed in raising the vessel."

12. For an improvement in *Bell Hanging;* James Russell, New York, October 10.

The particular arrangement of the parts of this apparatus cannot be explained without a drawing. The object proposed is to save room, and make one bell answer for a number of apartments. A box, or case, is fixed in the room containing the bell; within this box there are a number of sliding bars corresponding with the number of apartments from which bell wires are to extend. There are also in this box a number of plates of metal, equal to the number of sliding bars, or of wires; these plates are so constructed, that when a wire is pulled, one of the plates of metal tilts, by the action of its corresponding bar, and a disk, attached to it, having the number of the room on it, projects through a groove formed in a brass plate at one end of the box, and thus indicates the apartment where the servant is wanted. Each of the bars is made to act upon the same bell, and when a second wire is pulled, it replaces the index of the former, as its own is displayed.

The contrivance is ingenious, and will evidently answer the purpose intended; it is particularly calculated for large establishments.

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13. For an improvement in the machinery for *Spinning Cotton, Silk, Flax*, and other materials; George Addison, and Samuel H. Stevens, New York, October 10.

The end proposed to be accomplished by this invention is similar to that which Mr. John Thorp, of Providence, and some others, claim to have attained by other means. Those intimate with the subject will recollect the plans of Mr. Thorp, for dispensing with the common flyers, as described in our last volume, and partially also in this number. The present plan bears a nearer resemblance to the "Ring groove spinner" than to either of the others.

Circular openings are cut out in the wave rail, around the spindles. Metallic rings, of a suitable size, are fixed above, or within, these openings. These rings are made very true, and smooth, and in such a form that a light piece of metal may clip round their edges, by means of small projection, or wires, attached to them for that purpose, this latter piece is called a *traveller;* it passes freely round the ring, being carried by the thread as it is spun; there is an opening, or eye, in the traveller, through which the thread passes.

The specification notices the various plans which have been heretofore pursued, for the purpose of showing that they differ, specifically, from that now patented. There is no particular claim, as nothing is described but the part which is accounted new. It is stated that "the general resulting benefit of this improvement is of great importance in the art of spinning. The operative parts of spinning machinery, viz. the flyer, and the bobbin, and spindle, by means of this invention, may be so much reduced in size and weight, that spinning machines having this improvement need not be so massive, or heavy, or strong, or occupy so much room as heretofore. Buildings of less solidity and extent may take the place of the massive and

expensive structures heretofore deemed necessary, and the power used to drive a thousand spindles on the old construction of machinery, will drive twice as many on this construction."

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14. For making *Bit-stocks of Composition;* Augustus Phelps, Marlborough, Hartford county, Connecticut, October 10.

The following is the specification:

"The bit-stock is composed of cast-iron and brass. The main, or lower part, is of cast-iron, the head and neck, or top part, of brass. The principle and operation of said bit-stock are the same as those that are now in general use."

We have known bit-stock of *cast-iron*, with heads of wood, sheet-iron, brass, or copper, for more than thirty years. Many hundred of them, made in imitation of the celebrated Scotch stocks, have been imported from England, and the purchaser has frequently found, to his cost, that his iron stock has broken by a fall from his bench, and that it was not in the power of the smith to weld it.

We can assure the *inventors*, or *discoverers*, of cast-iron hammers, tire, horse shoes, stocks, &c. &c., that they have been so completely forestalled by the English in the art of casting all those articles which ought to be made of wrought iron, as scarcely to leave room for any *new discovery* upon the subject.

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15. For a *Machine for Making Shingles;* Joel Barnes, Cornwall, Litchfield county, Connecticut, October 10.

A wheel of wood, about six feet in diameter, is made to revolve, vertically, upon gudgeons; a knife, or cutter, is fixed upon one face of this wheel, projecting from it the thickness of a shingle. The bolt, or block, to be cut, is placed upon a proper bearing attached to the frame, and is forced by hand, against the face of the wheel when in motion; the wheel is to revolve about sixty times in a minute. There is, of course, an excavation in the wheel, under and behind the knife, for the escape of the rived pieces. This constitutes the whole of the machine, and as there is no claim to any particular part, we are to consider *the whole* as new.

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16. For a *Rolling Valve* for supplying the boilers of steam engines with water; Elam Young, Tate township, Clermont county, Ohio, October 10.

The rolling valve is in form like the key, or plug, of a common cock, fitted into a socket, and standing horizontally in a reservoir of water, from which the boiler is to be supplied.

The valve, or key, has two chambers formed in it, at 90 degrees apart; these are filled with water alternately, through perforations in the socket, the valve is worked backwards and forwards by means of a pitman from a crank, which carries the water down to an opening in the lower part of the socket, communicating with the boiler. It is intended that the valve should be self-regulating, by causing

the chambers to contain the proper quantity of water for the generation of steam.

The claim is, "the supplying the boilers and generators of steam engines by means of a rolling valve."

The great objection to valves of this description is their wear; the four-way cork, and rotary, or vibrating valves, acting upon this principle, are necessarily subject to this objection, but for which, a valve such as that now described, would be preferable to a forcing pump. The idea of such a valve is not new; we cannot immediately turn to any printed evidence of this, but it has been familiar, and matter of frequent conversation with us for years.

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17. For an improved *Washer and Churner;* George B. Gibbs, Pike, Bradford county, Pennsylvania, October 10.

Mr. Gibbs thus describes his washer and churner, "the form is, or resembling, the frustrum of a pyramid; the diameter of the base from two to four feet, that of the top from six to twenty inches, through which passes a pin, or fulcrum, upon which a lever, from three to ten feet, swings, with or without a joint, cog, or wheel, to which is attached an open paddle, with two posts, which are connected by two or more slats, which is moved within the cylindrical box by the above mentioned lever." GEORGE B. GIBBS.

If the above description appears to be obscure, we can assure our readers that the drawings which accompany it possess the same quality in an equal degree; it is much to be doubted, however, whether any thing be lost by this defection, as we think that most housekeepers employ a better washer, and those who keep cows a better churner, than most of those which are patented, although they stand upon *two feet*, and have, therefore, a lesser base than that of Mr. Gibbs.

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18. For a *Leather Tree-saddle;* Matthias Holdeman, Trapp, Montgomery county, Pennsylvania, October 10.

As the title indicates, this patent is taken for making a saddle-tree of leather, instead of wood. The mode of cutting and joining the pieces so as to obtain the proper form, is described in the specification; when made, the whole is to be well sized, or stiffened, with glue. There is no particular claim, the object being to secure the right to make saddles with leather trees.

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19. For an improvement in the common *Saw Setter;* Ira Hatch, Westford, Chittenden county, Vermont, October 12.

This is a new edition of the saw-set, but we cannot say an improved one, as it is precisely like such as have been before patented. The set is made in the common way; it has upon its handle, or shank, a sliding piece, tightened by a screw, with a gauge screw tapped into it, which, when the proper set has been given to the tooth, will bear

against the side of the saw. What is claimed as *new*, is, "the gauge to regulate the bevil required to the teeth in setting the saw."

There are some half dozen patent saw sets operating upon this principle, but we believe that workmen in general prefer to set their saws by the old saw set, or with a punch. Were saws soft, or perfectly equal in their texture from end to end, these patent saw sets would answer a good purpose; but this, according to our experience, is rarely the case, and consequently the eye and the hand become the best guides.

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20. For *Raising Boats from one Level to another, on Canals*, by means of inclined planes; Ephraim Morris, Bloomfield, Sussex county, New Jersey, October 13.

The design is to draw a cradle, or car, containing a boat, up an inclined plane, by the power of water wheels. As this is not new, the patent is taken for several improvements which are specified, but which cannot well be described in words. Hitherto the inclined planes which have been constructed have disappointed the anticipations of their inventors; and, although we have often been told of perfect success in newly constructed works of this kind, the searching operator, time, has pointed out great defects, and has still left a good inclined plane, a desideratum. We are not aware that the plan now proposed offers any striking novelty, but should it remove the difficulties experienced in existing structures, its merits would be of a high order.

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21. For an improvement in the mode of *Hanging and Straining Saws;* Levi Chapin, Walpole, Cheshire county, New Hampshire, October 13.

The plan proposed is intended to render the ordinary saw frame unnecessary in the straining of mill saws. Two wheels, or drums, are placed one over the other, each working upon gudgeons. The boxes of the upper gudgeons are to be stationary, those of the lower ones are to work in a slat, so that by means of a wedge, or a lever and weights, the drum may be forced down for the purpose of straining the saws. A band, or chain, passes over the upper drum, and another under the lower drum; to the ends of these bands, or chains, saws are to be fixed by stirrups; the two chains, and two saws, when thus united, form a continued band round the two drums, or wheels; an alternating, crank motion, communicated to one of the drums, will cause the saws alternately to ascend and descend. The novelty, and improvement claimed "consists in hanging two saws, without the use of saw frames and gates, and wholly relieving the crank, or power, necessary to operate saws, from the heft or burthen of any apparatus necessary to hang or strain saws, leaving all the power to operate the saws in the work. The principle is intended to embrace all the various forms in which sawing is required, whether by means of wheels, cylinders, or drums, or parts of either, or by use of chains,

ropes, belts, or springs, or by forcing the strain by the power of the wedge, lever, or screw, of whatsoever materials they may be formed."

The above claim appears to us to be much too broad and general. The particular mode described by the patentee is probably new, but the idea of a saw acting as a band, strained over drums, is old. By turning to the article SAW, in Rees' Cyclopædia, it will be seen that a patent was obtained in England, many years ago, for a saw forming a continued band, working over two wheels, or drums, not by a vibratory, but by a continued motion.

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22. For a machine for *Scalding and Napping Hats;* Daniel Baldwin, Ithaca, Tompkins county, New York, October 15.

The machine described is a sort of box, to be placed over a planking kettle, or large boiler. At the top of the box is a pulley, worked by a rope, for the purpose of letting from ten to fifty hats at a time descend into the heated liquid, or drawing them up at pleasure. There, of course, is no bottom to the box, and the hats are contained in a cloth suitably fixed for the purpose, and which, with other parts, is particularly described in the specification.

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23. For a *Feather Cleaning Machine;* Charles Toupet, New York, October 15.

This is a sort of bolting machine, in which the feathers are to be stirred and beaten about, and the dust separated from them. A long trough is made, the upper part of which is of leather, formed and supported like a wagon tilt; at the lower part is a drawer, covered with wire grating, to receive the dust. A frame, like that of a bolter without its cloth, is made to revolve within the trough by means of a crank; from this frame small pieces of wood, or sole leather, project, which are to act upon the feathers. The machine is placed in an inclined position; the feathers are put in through a door at the upper end, and when they arrive at the lower, are said to be "perfectly bright, clean, and free from all impurities." There is no claim, the whole machine, therefore, is patented.

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24. For a churn called a *Box Churn;* Thomas and Lansing Morrison, Groton, Tompkins county, New York, October 16.

A box which may be 18 inches long, and 14 wide, or of any other length, width, and depth, is to have a top, bottom, sides, and ends, all put together so as to hold milk or cream; gudgeons are to be fixed on the sides of said box, to one of which a crank must be attached to turn it. The lid must fit so well that the contents may not leak out; a faucet, or cock, is placed to allow the butter milk to run off, and if it will not do so when the box stands horizontally, it may, by means of the crank, be held in a sloping direction, "and the butter will remain in a ball, or balls, in the churn." So endeth the description, and, very wisely, nothing is claimed.

25. For a *Harpoon* of cast-iron and wrought steel, with a wrought iron shaft; Jonathan Sizer, 2nd, New London, Connecticut, October 16.

The following is the specification:—

"The head to be of cast-iron, zinc and tin, lead, or copper, so as to give the dart, or harpoon, sufficient strength. The edges, knife, or cutting part, to be either of wrought iron, or cast-iron, wrought steel, or cast steel; to be cast or rivetted in the head. The shank, or shaft, to be of wrought iron, wrought steel, or copper. The shaft, or shank, to be cast into, or firmly rivetted, on the head of the harpoon, and fixed therein strong and solid."

Of what materials our whalers will hereafter make their harpoons, we wot not, as nearly all, excepting the precious metals, are now patented. It is not the form of this harpoon that is new, but the *old* materials. We may expect to hear of a jubilee among the finny tribe, when they learn that they are not to be harpooned, either with iron, or steel, wrought or cast, zinc, tin, lead, or copper, excepting by permission of J. S. 2nd.

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26. For an improved mode of *Tightening Doors and Windows;* Stephen Hayward, Plainfield, Hampshire county, Massachusetts, October 17.

A fender is to be fixed by hinges at the bottom of outer doors; on the door sill, near the hinge side, a piece of iron is fixed to raise the fender as the door opens; strips are to be fixed in the rebate, or groove, of doors and windows, and to be borne up against their edges by spiral or other springs. We do not think it worth while to be more particular in describing this contrivance, and shall, therefore, only add the claim of the patentee.

"What I claim as new, and as my own invention, is the manner of raising and confining down the fender at the bottom of the door; also the pieces in the casing, borne by springs against the face of the door; also bearing the slides in windows against the sash, to keep the sash tight, and hold it when raised.

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27. For a *Churn;* James C. Barrett, Collins, Erie county, New York, October 19.

This is the most formidable churn which, to the best of our recollection, we have ever encountered. A very strong frame is made, upon which there are to be raised two fender posts, from 4 to 5 feet high, from 2 to 3 feet wide, and from 2 to 3 inches thick, for a *common churn*, but larger for those which are of extraordinary size. Within these fender posts are three cog wheels of 2 feet 6 inches, and 2 feet diameter respectively, and four pinions of 8 inches diameter each. The first pinion is to be acted upon by the moving power, the last is to give motion to the dashers of a churn, the intervening wheels and pinions gearing into each other, *secundum artem*.

The moving power is a heavy vertical rack, working up and down in a groove, and when in gear, taking into the first, or upper pinion.

"This vertical rack is about 10 feet long, and from 2 to 6 inches square, more or less, as may be required; and the teeth from top to bottom of said rack may be made of cast or wrought iron, or may be wooden pins, and be so adapted as to work into the wheels and pinions." This rack is to be wound up by a crank, and by its weight is to set the whole train at work, and of consequence churn the butter at the end of it.

"What I claim is the peculiar arrangement of the apparatus above described, with the heavy descending rack employed as the moving power."

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28. For an improvement in the *Knob Lock;* James Patterson, Birmingham, St. Clair township, Alleghany county, Pennsylvania, October 19.

The latch, or spring bolt, of this lock, is forced forward by a spiral spring instead of the kind of spring ordinarily employed; this is all that is claimed. In spring catches for round tea tables and candle stands, such springs have been used upon the tail of the bolt, for forty years at least, nor are they new in locks; they have before been patented in the United States, and it is to be doubted whether the claim was then good.

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29. For an improvement in the *Application of Hydraulic Power;* Zebulon and Austin Parker, Coshocton county, Ohio, October 19.

The patentees claim to have invented improved methods of using water, by "combining percussion with reaction, applied and exemplified in,

"1st. A compound vertical percussion and reaction water wheel for saw mills and other purposes, with the method of applying the water on the same.

"2nd. An improved horizontal reaction water wheel, with the method of combining percussion with reaction in it.

"3d. A method of combining percussion with reaction on common reaction wheels, or those already in use."

After describing the particular manner in which they construct their wheels, the patentees say, "the parts of the above described machinery claimed as original, are as follows: 1st. The compound vertical percussion and reaction wheel for saw mills and other purposes, with two, four, six, or more wheels on one horizontal shaft. The concentric cylinders enclosing the shaft, with the manner of supporting them. The spouts which conduct the water into the wheels, from the penstock, with their spiral terminations between the cylinders. 2nd. The improvement in the reaction wheel by making the buckets as thin at both ends as they can safely be made, and the rim no wider than sufficient to cover them. The inner concentric cylinder. The spout that directs the water into the wheel; and the spiral termination of the spout between the cylinders. 3d.

The rim and blocks, or planks, that form the apertures into the wheel, and the manner of forming the apertures. The conical covering on the blocks, with the cylinder, or box, in which the shaft runs; and the hollow, or box gate, in any form, either cylindrical, square, rectangular, or irregular."

It will be seen from the foregoing, that there is considerable complexity in the apparatus patented; and it may be collected, that the plan proposed consists, mainly, of enclosed wheels, with curved buckets, and certain spiral convolutions in the openings through which the water is to act. It is in fact a modification of the principles of Barker's and the tub wheel. The patentees state that they have, with great advantage, put their plan into operation. We apprehend that if this be the fact, the mills with which they have made a comparison are not such as are constructed upon the best principles for economizing water. The ordinary tub wheel is recommended by its simplicity, where water is abundant, but where it is necessary to save water, and it can be applied to an overshot, pitch-back, or breast wheel, we despair of seeing it more efficiently employed; these, it is true, may be, and generally are, badly constructed, or improperly geared; but where their velocity is duly regulated, their buckets properly formed, and the water delivered upon them at as great a height as possible, its whole effect, which is due to its gravity, will be obtained. In practice Barker's mill has been abandoned.

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30. For an improvement in the manner of *Inking Types, Stereotype Plates, Wood Cuts, &c.*, by means of an apparatus denominated the "Gravitating Inking Roller Apparatus;" William J. Stone, Washington, D. C. October 20.

Some account of this invention will be found among the specifications in the present number; we expect, shortly, to give the whole specification, with engravings.

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31. For a *Floating Saw Mill;* John C. Ely, New York, October 21.

"Construct a saw mill in the most approved manner; place it on a scow, boat, or any other floating vessel, of sufficient strength and buoyancy. Make two paddle wheels, connected by an axle, one on each side of the boat; put a steam engine on board this vessel; let it be so geared as to move the paddle wheels, as well as to drive the saw mill.

"It of course saves all the expenses of erecting dams, and conveying the timber to saw mills, as the floating saw mill can be moved to the most convenient places on the river for business."

The claim is to "a floating saw mill, to be propelled by steam or animal power, and moved from place to place where timber is found."

We see so many objections to this mill, that we cannot attempt an inquiry into its merits without more time and space than we can now afford.

32. For a *Washing Machine;* Henry Shiveley, Robert S. M'Euen, and John Lindsey, Fredericksburg, Wayne county, Ohio, October 21.

To arrive at once at the merits of this machine, we shall leap over the *descriptive* part, and attend to the *application*, which is in these words; "before commencing to wash, the *operator*, with the fluted roller, is thrown up out of the box, the clothes thrown in, and spread on the fluted bottom, and the fluted roller brought down upon them by the operator, and the operation of washing commences by moving the fluted roller backwards and forwards over the clothes by means of the operator." The *operator* is the name given to the part which is to be pushed backwards and forwards.

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33. For *a Plough;* Reuben Reeder and Stephen D. Ashley, Hamilton county, Ohio, October 21.

Every part of this plough is to be made of iron, with the exception of the handles, and these may be so made, if thought proper; its general form differs but little from that of other ploughs, and in what its particular merit lies we are not told, and cannot tell, as there is no claim.

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34. For *a Plough;* Timothy Miller, Pittsburg, Pennsylvania, October 23.

The improvements claimed are to "the share, cutters or coulter, and mould board, being made of cast or wrought iron, or part of wood and part iron, connectively forming one entire unbroken surface, so that the edge of the sod, when cut, will rise in a concave, or hollow, formed by the consolidation of the cutters and mould board, on an inclined plane, continually increasing in elevation, until it shall be elevated to its greatest height, near the upper edge and in the centre of the mould board from the centre of the beam to the extreme hinder point of the mould board."

"There being a first and second cutter, both having circular edges, the second is continued from the first one to near the under side of the beam, and inclined to the furrow side, so that the centre of the edge is perpendicular with that side of the beam. And the value of this invention consists in this, that whatever may escape the first cutter, will be cut by this second one, and that grass, or weeds, cannot accumulate under the beam, which, if they are not carried off by the sod, will immediately fall off on the land side, and clear the plough."

The foregoing is nearly the whole of the specification, with the exception of the drawing and references, which describe particularly the form, dimensions, and connexion, of the respective parts.

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35. For a *Press for Pressing Cheese;* Richard M'Omber, Galway, Saratoga county, New York, October 27.

The press described is a compound lever press, the first lever acts immediately on the cheese, whilst it is itself acted upon by the se-

cond lever. At the connexion between the two levers, there is a spiral spring made of No. 4 wire, which is to continue to act by its elasticity, after the second lever has been forced down and confined.

Neither the spring or any other part is claimed, and we are left, therefore, to the conclusion, that the compound lever is new, as well as all the other parts described. The only novelty we see is the spring, and why a weight upon the end of the second lever would not produce all the advantage expected from the spring, we cannot divine.

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36. For a method of *Reducing Friction in Rail-road Carriages;* Hugh Finlay, Baltimore, Maryland, October 27.

This is a new form of friction saving machinery. The main axle and wheels of the carriage are to be made as usual; two strong rings, the insides of which are rounding, are suspended, one near each end of the axle, within the wheels. Two pulleys, or wheels, having their edges grooved to fit the insides of the rings, are connected together by an axle, and are then placed within the rings, so as to hang below the main axle. The load is to be suspended upon the axle which connects the pulleys.

In what respect this mode of reducing friction is superior to that of Howard, Winans, and others, we are not informed, and according to our judgment it would be difficult to discover. Several objections to the plan forcibly present themselves, but we cannot now stop to discuss them.

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37. For an improved *Perambulator, for Ascertaining the Distance Travelled* in a Chair or other Carriage; Anthony Gifford, Westport, Bristol county, Massachusetts, October 27.

A small brass box contains the wheels and principal part of the machinery. This is so fixed, that a lever, projecting from it, is acted upon by a steel cam, screwed upon the inner end of the hub, or nave, of one of the wheels. The lever, cam, and connecting arms, are particularly described and claimed.

Several similar machines have been constructed and used, some of which have been acted upon by a cam on the nave, in a way very similar to the present; it may, therefore, be doubted whether the parts claimed possess the requisite novelty.

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38. For an improvement in the construction of *Trusses for Reducible Hernia;* Amos G. Hall, Surgeon, New York, October 28.

The petition sets forth that three successive patents have been previously taken for the same invention; the first dated 17th July, 1817, the second, 27th February, 1823, and the third, 19th August, 1824, "all of which have been found defective, and the two former have been cancelled;" and prays that that of 1824 may also be cancelled and a new one granted for the remainder of the term, 14 years, from the date of the first patent.

Hull's truss is too well known to require a description here; the claim of the patentee has already been investigated in court, and we believe is, in some way, still a matter of litigation; under these circumstances we should deem it improper to make a comparison of, and give our views respecting the four respective specifications, or descriptions, of this instrument which have been furnished. It is, probably, to meet some legal question that this last patent has been obtained, which will expire in the year 1831.

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39. For an improved *Cooking Grate;* Thomas Vinton, Philadelphia, Pennsylvania, October 29.

The drawing of this grate is in the hands of the engraver, for the purpose of accompanying the specification, which will hereafter be published.

Although this invention is of a very recent date, we have received assurances from persons of judgment in Philadelphia, who have it in use, that its operation is perfectly satisfactory. The grate is to be placed in a common kitchen fire-place, and it may advantageously be employed, at the same time, to bake, roast, and boil, all of which it effects by means of an open fire, in a grate of the usual construction.

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40. For an improvement in *Pumps;* John P. Bell, New York, October 31.

Had we not been informed that this is an improvement, we should really have concluded that the contrivance was intended, like a roundabout walk, merely for exercise, as it is admirably calculated to increase friction, and waste power.

There are two pumps, the piston rods of which are worked by means of two eccentric circular wheels, the centre of motion of which throws them out about 10 inches each way. The peripheries of these eccentrics work between two bars, or guides, standing at right angles across each of the piston rods, at a distance from each other equal to the diameter of the eccentrics.

There are three cog wheels, two of them about 20, and the other about 10 inches diameter. The two first gear into each other, their gudgeons being on the same horizontal bar; upon the faces of these wheels the eccentrics which work the piston rods are fixed. The driving wheel is placed above, and may be made to gear into either of the others at pleasure.

The claim is to "the mode of using eccentric wheels, when applied to pumps for raising water, as above described."

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41. For an improvement in *the Art of Milling;* Jesse Reeder, Lebanon, Warren county, Ohio, October 31.

An iron mill is to be cast, like the common mill used for coffee, and many other purposes. The patentee "claims an improvement in the art of grinding; as his mill is found to make a more round, even, and lively meal, than is made on the common mill stones; but especially does he claim the invention of picking, cutting with a cold chisel, or

sharpening and dressing the above described, and all metal mills used for grinding grain."

The main furrows are to be formed in casting, or they may be cut in afterwards; these furrows are to be cut over their whole surface, with a sharp chisel, or pick, so as to be covered with teeth in the form of a float, or single cut file; and when dull, are to be sharpened in the same way.

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42. For an improvement in *Making Boots;* Alden Burdick, Carroll, Chautauque county, New York, October 31.

This improvement consists of machinery which is intended to stretch the leather for boots upon the crimping board. Three pincers are placed on each side of the board; and these are attached by bands, or cords, to rollers turned by a crank, and held in their places by a ratchet wheel. The belts are attached to one handle of the pincers, and pass through a mortise in the other, by which they are made to grasp the leather firmly.

DESCRIPTIONS OF AMERICAN PATENTS.

A short description of an improved Inking Apparatus, to be used with the ordinary Screw, or Lever, Press. Patented by W. J. STONE, *of Washington, in the District of Columbia, October* 16, 1829.

THE inking apparatus for which Mr. Stone has obtained a patent is to be appended to the ordinary printing press, and to obviate the necessity of employing a person to ink the form. As we shall, probably, at an early day, publish the specification, with drawings, a brief notice of the invention is all that we now propose to give.

The roller by which the types are to be inked, is to be made of the usual composition, or an improved roller is to be formed by interposing a layer of some substance impervious to oil, between the blankets which give elasticity to the roller, and the leather with which it is covered. The ink is to be contained in a trough and supplied to the elastic roller by one of iron, in the same way in which it is usually supplied in power presses. The mode of spreading the ink, so as to equalise it is new. This is effected by two rollers working against the inking roller, these are called equalising rollers. They have a fillet, or thread, extending from end to end, like a square threaded screw, and operating as right and left handed screws, force the ink in reversed directions.

The inking is effected by a motion communicated to the apparatus by the traversing motion of the bed and form, and takes place whilst the printed sheet is removed and replaced. A rack, or other similar contrivance is placed under the bed, and geared to the inking apparatus. The bed is allowed to acquire a certain degree of momentum before it engages the rack with the wheel, or pinion, so that but little extra resistance is felt by the pressman. There is an iron frame, or rail-way, which works upon pivots, so as to be inclined either towards,

or from the form to be inked. Upon this rail-way, an iron roller runs backwards and forwards, according to the inclination of the frame which guides it. From this iron roller, arms extend to the inking roller, which is made to traverse over the form by the gravity of the iron roller. The mode of tilting the frame, or rail-way, will be described hereafter; it may be effected in various ways, and is not, therefore, intended to be confined to the one adopted.

The points claimed, are, the carrying the inking roller forwards and backwards over the form by the descent of a gravitating body, like the iron roller described, by reversing the inclination of the bars upon which it runs. The communication of motion from the bed to the inking roller, either by a rack, or other gearing. The allowing the bed to acquire momentum before it acts upon the rollers. The use of a stratum, or layer, impervious to oil, as above noticed; and to the mode of equalising the ink.

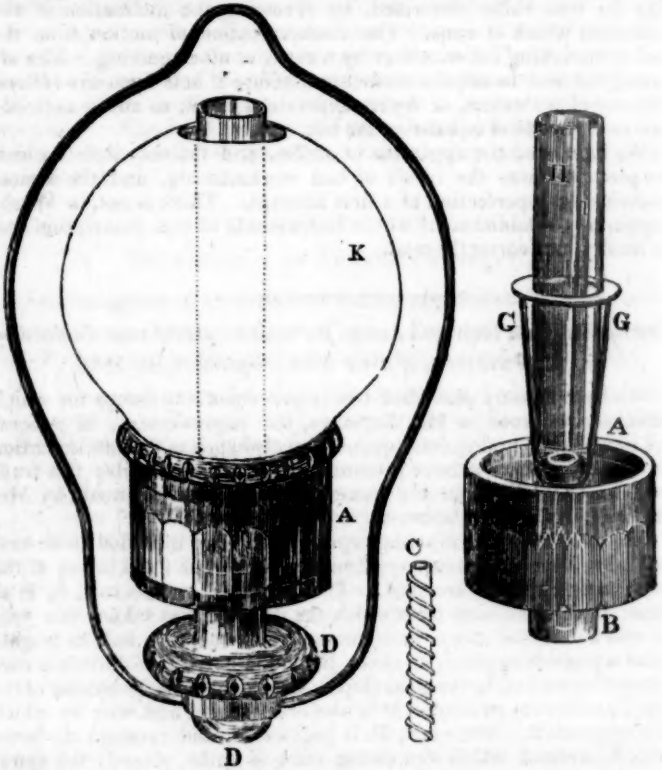
We have seen the apparatus in action, and the only defect which we perceived was the result of bad workmanship, and the almost unavoidable imperfection of a first attempt. There is not, in Washington, any establishment where instruments of this description can be readily and correctly made.

Description of an improved Lamp, for which a patent was obtained by ISAIAH JENNINGS, *of New York, September* 10, 1829.

WE have already described two improvements in lamps for which patents have issued to Mr. Jennings, but improvements in general are progressive, and it consequently rarely happens that an invention good in principle, is at once presented perfect in its details; this truth has been exemplified in the successive improvements made by Mr. Jennings, in the lamp before us.

The accompanying drawing represents a lamp intended to be suspended in a hall, or elsewhere; it may, however, be fixed in any of the ways in which lamps are used. The oil vessel, or reservoir, A, is of glass; in the specimen from which the drawing was taken, this vessel was about four inches in diameter, and two and a half in height; it has a projecting piece, or neck, B, on the bottom, to fit into a corresponding socket, in the glass step D, D, which forms the bottom of the lamp, and serves to sustain it in the brass socket and wire by which it is suspended. The neck, B, is perforated, and receives the brass tube, C, around which the cotton wick is to be placed; the spiral threads which surround this tube, serve to raise the wick when necessary; it is fixed in the neck of the reservoir by means of a cork, perforated to receive it. The draft of air through this tube to supply the inside of the wick, is admitted through the openings cut in the glass step, as seen in the drawing. The brass tube is about half an inch in diameter, and three inches in length, its upper end is even with the top of the reservoir. The oil which may drip from this tube is collected in the lower part of the step, from which it may be cleaned when necessary.

The wick, when placed on the tube C, does not reach to the top of it by about half an inch, as this wick is not intended to burn, but merely to supply oil, by capillary attraction, to a supplementary wick, which is to be burnt, and renewed when wanted. This wick may be made by winding a strip of coarse cotton, of about half an inch in width, around the finger, and tacking it so as to form a ferule, or wick, of the thickness required; the intensity of the light depending, principally, upon the thickness of this ferule. A second tube of brass, or copper, is made to slide over the wick, but not to compress it;



this second tube is seen at the bottom of the burner; the upper part, which receives the ferule of cotton, is larger than it is below, to admit of a greater thickness of wick. Three wires, G, G, are soldered on the outside of this last tube, and to a metallic ring above, to receive the glass chimney, or burner, H. It is proposed sometimes to make these burners of mica (usually called isinglass) by bending it round and uniting the edges by a grooved strip of thin metal, as shown at I. By turning the outer metallic tube, the wick upon the spiral part is raised, and pushes up the supplementary wick, which, however, is

not frequently necessary. The outer ferule reaches to, and rests upon, the bottom of the reservoir, and is perforated with holes to admit the oil freely to the wick.

A glass globe, or vase, K, surrounds the burner, and fits by a lower flanch, or rim, into the reservoir, the chimney, or burner, passing through an opening in its top. The lower part of the globe, or vase, is perforated, as represented, to supply air to the outside of the wick.

We have one of these lamps in use; it is elegant in its appearance, and perfect in its operation; it is generally employed as an entry lamp, but when extra light is required, by using the supplementary wick of an increased thickness, the illumination is really splendid, being equal to that of several ordinary Argand lamps, and strongly resembling that from gas. The quantity of oil consumed, in this case, is, of course, much increased, but is less than was anticipated. When used with a thinner wick, as an entry lamp, the supply of oil in the reservoir will last for a week.

The original description of MR. JOHN THORP'S *improvements in Spinning, by substituting a Ring, or Can, for the ordinary Flyer. Received at the United States Patent Office, March 31st,* 1828.*

State of Rhode Island, Providence county,
Smithfield, March 21, 1828.

To the Hon. the Secretary of State of the United States.

SIR,—I take the liberty to forward to you the following account of some improvements, to be lodged in the patent office as a safeguard, until I can forward the other requisites for obtaining a patent.

The subscriber's improvements in spinning are as follows, viz. *a ring* which encompasses the bobbin, answers the purpose of a flyer, and around the surface of this the yarn revolves, being drawn by the bobbin as it twists and receives it. Said ring is used instead of a flyer, like the arms of which, it serves to keep the yarn at a proper distance from the bobbin, and also to direct and distribute it thereupon; said ring is kept in its proper place by a *circular plate*, which also encompasses the bobbin, and has in it a groove formed by one or more circular lips or margins projecting therefrom. Said plate is confined to the bobbin rail; and in said groove the ring is loosely placed, allowing the yarn to revolve around its surface, or when a greater friction is required, a notch may be made in the ring, in which the yarn can lodge, and thereby dragging the ring and causing it to revolve in said groove. The said plate is open at one side, giving the yarn a free passage to the ring. The same use and purpose of the above ring can be performed *by a cup, or can*, placed on the end or top of a still spindle, the rim or edge answering the purpose of said ring. The object of the above described improvements

* At the request of Mr. Thorp, we insert the above letter to the secretary of state, for the purpose of making known the date of his first application.

is to dispense with the flyer, and thereby with a great friction which the arms of the flyer will always create, also to increase the length of the bobbins, so that a greater quantity of yarn may be spun before they require shifting; and furthermore, to give a greater speed to the spindle than the arms of the flyer will allow of, and also to enable manufacturers to spin slack twisted filling on to a bobbin suitable for the shuttle, &c. The above specified improvements I claim as my invention, verily believing myself to be the original inventor and discoverer of the same.

Yours, &c.

JOHN THORP.

Observations on Paddle Wheels now used in Propelling Steam Vessels, and on those recently invented and patented by JACOB PERKINS, Esq.*

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

SINCE the application of steam to the purposes of navigation, no description of machinery, except the steam engine itself, has occupied so generally the time and attention of mechanics as the paddle wheel. Inventions endless in variety have been patented for propelling steam vessels; till lately, however, none have been found so efficient, durable, and economical, as the common wheel, notwithstanding its waste of power is very considerable.

When the dip of the common wheel is not more than $\frac{1}{10}$th of its diameter, the waste is erroneously supposed to be inconsiderable; but when it exceeds that proportion, the loss of power is confessedly in geometrical progression; it being found that if the wheel be immersed to half its diameter, the strain on the engine becomes so great as to leave very little of its force applicable to the propulsion of the boat.

Of course, sea going Steamers are, from the irregularity of the ocean's surface, more exposed to this injurious influence than vessels navigating rivers or quiet waters, where the dip of the wheel can be regulated.

It is obvious that the common paddle, when at the lowest dip, where it should have the greatest power, moves in water already disturbed by the preceding paddle, and it is evident that after the paddle has passed the lowest dip, it is not promoting the progress of the vessel, as it would do if it were acting in undisturbed water.

To obviate some of the difficulties above stated, an eminent individual, Mr. Oldham, of Dublin, has, in common with many others, taken great pains and incurred considerable expense. He constructed a wheel, the paddles of which enter the water edgeways, and by

* This communication was written in London, by a gentleman who witnessed the experiments of which he speaks, and was forwarded for publication in this Journal, by a person recently returned from England, who has himself examined the apparatus, and is perfectly satisfied of the correctness of the facts detailed.

machinery attached to them, gradually change their position, until, on their successively arriving at the lowest extremity of the wheel's rotation, they present a face at right angles with the keel; and then gradually revolving, leave the water edgeways. But the complexity, increased friction, liability to derangement, weight and expense of this wheel, were found more than to counterbalance its theoretical superiority.

Simplicity, durability, lightness, and cheapness, are requisites not to be dispensed with in the construction of paddle wheels. If with these essentials a wheel can be constructed to work with undiminished action at a dip ordinarily of $\frac{1}{3}$, and occasionally of one-half its diameter, without incurring a greater consumption of steam power than attends the common wheel when used in still waters, then a remedy will have been found for the great loss now experienced in sea going vessels.

Such a wheel has lately been invented by Mr. Jacob Perkins.

Those who have witnessed the Chinese method of sculling, must be strongly impressed with the superiority of that over the European application of the oar. The action of Mr. Perkins' wheel is not unlike that of the Chinese scull; in fact, the only difference is, that the motion of the scull is reciprocating, that of the paddle wheel in question, rotary; the rotary motion being clearly preferable, inasmuch as the frequent change of motion in the scull is so much waste of power.

Comparative experiments with the common and with the newly invented wheel alternately used in the same boat, have shown, that even at a shallow dip, the most appropriate to the common wheel, there is a very important gain with the wheel of Perkins. But when the wheels are each of them immersed to $\frac{1}{3}$ of their diameter, (perhaps an average dip for sea going vessels,) the advantage attending this newly invented wheel is scarcely credible.

The experiments alluded to were made in the presence of an eminent engineer, and were as follows: a boat was propelled by a weight falling a certain distance, attached to a line turning an endless band, running over a pulley fixed on the shaft connecting the paddle wheels. Two sets of paddle wheels, one on the common, the other on Perkins' principle, were put in succession into the boat. The two sets of wheels were nearly of the same weight, any little advantage in this respect being in favour of the common wheel. The boat moved round a basin of water measuring within 36 feet.

Old Paddles.

1st Experiment,	6 Rotations,	216 feet	in 3′.40″
2nd do.	5¾ do.	207	3. 40
	11¾	423	7. 20

New Paddles.

1st Experiment,	15¾ Rotations,	567 feet	in 8′. 16″
2nd do.	15 do.	540	8. 25
	30¾	1107	16. 41

In these experiments, the weight supplied the force of steam. They show that the same quantity of steam will propel a boat with Perkins' paddles 1107 feet in 16′. 41″, which with the common paddles moved only 423 feet in 7′. 20″. The saving in fuel, therefore, appears to be upwards of 3 in 5; 211⅛ being the moiety of 423, and 211 and a fraction being the 5th of 1107. Over and above the saving in fuel, these experiments show an increased speed of about 15 per cent., or a saving in time of 9 minutes in an hour. For 16′ 41″ : 1107 :: 7′. 20″ = 486, a gain of 63 feet on 423.

Facts are stubborn things, opposed as they may be to the theories of men of acknowledged ability. It has been asserted by certain eminent engineers, that the common wheel admits of but little improvement. If it cannot be demonstrated that much power is lost by the common wheel, then would those engineers be borne out in their dictum. But recent experiments in England and America prove the loss of power with the common wheel to be very much greater than had hitherto been imagined. If the loss were trifling, could a single horse on a towing path do the work of a six horse engine in the boat? Could 2 horses attached to the hawser of a boat moved by a 25 horse power engine, neutralize the power of the engine, stay the progress of the boat, and occasionally give her stern way? These facts, however, are well authenticated.

Engineers, who believe in the perfection of propelling machinery on the old plan, exultingly reply to these facts by making abstract inquiries; such as, whether a vessel can move as fast as the periphery of the wheel by which she is propelled? Whether, if a boat move ⅘ as fast as the periphery of the wheel, it is not considered fair speed? and then jump to the conclusion that the whole loss of power cannot exceed ⅕, and that, allowing for friction, it is absurd to expect to save much of that small proportion by any improvement. That this conclusion is premature, the following remarks are intended to prove.

Let it be supposed that a paddle wheel can be made of such power and to have such hold on the water as to move only 100th part faster at its periphery than the vessel it propels. The difference in such case between the relative velocity of the wheel and the vessel would be as 99 to 100. It is true the magnitude of the wheel would require steam power in proportion, and then the remedy would be as bad as the disease, but the case is practicable. To suppose, therefore, that the loss of power is only as the relative movement of the wheel and of the boat, is as absurd as it would be to assert, that inasmuch as the carriage wheel and its body move with equal velocity, it matters not what load the carriage contains. In the one case the speed or draught of the horses must be increased, so in the other must the steam power.

We will consider the subject, however, in a more tangible shape. There are four kinds of water wheels, of which the undershot assimilates more to the paddle wheel than the others; and the undershot wheel, it is acknowledged, loses ⅔ds of its power, that is to say, if 3 lbs. of water fall 1 foot on an undershot wheel, it will not communicate impetus sufficient to raise more than 1 pound to the height

of the fall. Let us examine these data in three points of view with relation to the paddle wheel.

1st. The undershot wheel is propelled by water descending on it.

2ndly. The water so falling is so directed as to strike the float boards at right angles with their surface.

3dly. Although the power is communicated by water moving at a quicker rate than the wheel, yet so soon as it has communicated a portion of its impetus to the wheel, that quantity of water left on the float boards and hurried round with the wheel, is dead weight, and serves only to impede the wheel's velocity, and so to diminish its power.

In all these particulars, the disadvantages attending the common paddle wheel are greater than those above described.

1st. The water cannot descend upon a wheel revolving on a plane of water.

2ndly. The paddles do not strike the water at right angles with their surface; yet the impetus given by the first paddle is the principal power, inasmuch as it is exerted on undisturbed water, all the others moving in water previously disturbed.

3dly. The inert body of water between the paddles, carried round by the wheel, must be greater than that taken up by the undershot wheel. And above all, the backwater is far more considerable with the paddles than with the undershot wheel.

Now if the loss of power with the undershot wheel is allowed to be $\frac{2}{3}$ds, and it has been demonstrated that the loss by the paddle wheel is greater than with the undershot, the result of the experiments herein stated will be the less difficult of belief, and efforts to improve the paddle wheel be less open to be characterized as visionary and unprofitable.

Mr. Perkins' improvements remedy, in a great degree, the losses of the common wheel, whether by indirect action or by backwater. The paddles are made to enter and leave the water edgeway; when at the lowest rotation of the wheel, their action is at right angles with the keel; each paddle enters into and moves in water undisturbed by any preceding paddle; and thus every paddle immersed is doing service, though in different degrees, at the same moment.

The new paddles show the greatest proportionate advantage when $\frac{1}{3}$d and upwards of their diameter is immersed. This degree of immersion would ordinarily amount to from 7 to 8 feet, instead of 2, the advantageous dip for the common paddle. The resistance of water being so much greater at the depth of 8 feet than it is at 2, too much importance cannot be attached to this material distinction between the two modes of propelling—Perkins' paddle being made more in the shape of an oar blade than of a float board.

As Perkins' paddles do not strike the surface of the water with their flat sides on entering it, the constant tremulous motion experienced in steam boats will be obviated. So violent is the concussion in a heavy sea with the common paddle, or if the wheel be much immersed, that the destruction of the paddle, and even of the shaft, or parts of the connecting gear, are not unfrequent occurrences.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Some observations on the opinion that Friction upon Rail-roads is in proportion to the time. *By* MINUS WARD, Civil Engineer, *Baltimore, Maryland.*

In a pamphlet published by the writer of this article, in April, 1827, upon the subject of the Baltimore and Ohio rail-road, an attempt was made to demonstrate that the notion advanced by some of the English engineers, viz. "that the friction upon rail-roads is in proportion to the time," was founded in error—that there was, consequently, no danger of a locomotive engine running off with an accelerated velocity. The arguments which were there used were thought sufficient to convince any one that the friction, although it is not increased in its tractional amount, by an increase of velocity, is, nevertheless, *in proportion to the distance.* But it appears, the opinion that the friction is as the time, is still entertained by some. It has even been publicly taught, since the publication referred to above, that the friction upon rail-roads is in proportion to the time; from which it would appear, that the question was still considered by the public a doubtful one.

As every hint upon a subject of so much importance may be thought interesting, we have thought proper to lay before the public some additional views of the subject, and endeavour to demonstrate the truth of the proposition here maintained without reference to the power of steam, that being a subject which few understand.

In the first place, we are all, it is believed, prepared to admit the correctness of the experiment made by Roberts, see "Operative Mechanic," page 668. But what is the inference to be drawn from that experiment? we contend that it proves nothing more than this, that the tractional resistance, or pressure, or energy, or tension, (by none of these terms is meant power) which friction opposes to any agent employed to overcome it, is not increased by an increase of velocity. But does this experiment prove that the *power* consumed in overcoming this constant resistance for a given space, is not in proportion to that space. It is believed it does not. To make our reasoning upon a subject of this kind clear and comprehensible, it is adviseable that we should imitate the geometrician, and endeavour to define the meaning of the terms which we intend to make use of. What then shall we understand by the word friction; is it mere pressure? No. Is it mere velocity? No. All that we know about it is from its effects; we know from these, however, that it causes a resistance, let its definition be what it may. To what standard shall we compare it when we wish to measure its amount? we know of no standard to compare it to, except power, for unless motion is produced, friction is not overcome, and we are certain it requires power to overcome friction. But here again it is necessary to define what is to be understood by the word power (mechanical power of course.) Is it mere pressure? No. Is it mere velocity? No. Is it the product of the two? No, but it is measured by the product of the two. We know

nothing of power but what we can gather from its effects, from these we have learned that it is in proportion to the tractional force, pressure, energy, or tension, multiplied by the velocity with which the body is impelled by this tractional force, pressure, energy, or tension. We would here beg leave to remark, that it would seem a definite term was wanting to express the simple action, or traction, or pression, or tension, of an agent upon its patient, considered independent of either time, space, or velocity; and, for want of a better, it is proposed that the term *confliction* be adopted to express this action, whether it be a pression or tension; we would then say that mechanical power was measured by multiplying the confliction into the velocity of which the confliction was the cause. Mere pression where no motion is produced, cannot be said to be a transfer of power, for how can power be transferred where none has been consumed? that no power has been consumed is evident, when we consider that the product of two factors is known to vanish the moment that one of the factors vanish. Before motion is produced power has not begun to flow; has not commenced consuming upon itself; but the moment motion is produced power has commenced consuming upon itself.

Now we shall find that a power necessary to overcome a *constant* resistance will not be in proportion to the time, for power being measured by the product of the factors, one of these, viz. the confliction, will be constant, and will be equal to that to which it is opposed, viz. the constant retarding something which we call friction. But the other factor, of which power may be said to be composed (or rather the magnitude which we take as the representative of power) namely, the velocity, will be variable, being as the space described in a given time, and the product of these two factors will be variable, increasing as the velocity increases, and will be in proportion to the space, let the time be what it may.

Having thus shown that a constant retardation, which would be measured by a given tension (the bending of a given spring to a given point, for instance) is that which would require a certain power to overcome it and produce motion, which power is in proportion to the distance passed over, it is hard to conceive how friction can be fairly said to be in proportion to the time.

If we were to regard friction as a something which we might compare to mere tension, it might in this sense possibly be conceived to be independent of either time or space. But when we seek for the amount of friction, the sum total of all its magnitudes, which existed, or which were exerted, or elicited, while passing over a given space, and find that it requires a power to overcome this amount of friction in the proportion of the velocity and confliction jointly, which confliction is equal, and opposite to the retardation caused by friction, we are surely justified in saying that the *amount* of friction is in proportion to the space, for if we were even to refuse to admit, that the friction was in proportion to the space, still the fact, of the *power* necessary to overcome it being found to be in proportion to the space, would not admit those conclusions to be drawn, and those effects upon rail-roads to be anticipated, which have been drawn and anti-

cipated; we have been told (publicly taught,) that at a certain vast velocity, a car upon a rail-road would be borne along by the impulse which had been previously given to it, with hardly any additional consumption of power! We have been also told that a high velocity once attained, it would require no more power to maintain this high velocity than it would a lower velocity!

MINUS WARD.

FRANKLIN INSTITUTE.

Monthly Meeting.

The stated monthly meeting of the Institute was held at their Hall on Thursday evening, November 26, 1829.

MR. JOSEPH M. TRUMAN was appointed chairman, and

WILLIAM HAMILTON recording secretary, pro tem.

The minutes of the last meeting were read and approved.

The following donations were presented, viz.

The Philadelphia Monthly Magazine, vols. 1 and 2.

Essays on Public Charities, by M. Carey, Esq.

Extracts from the Medical Ethics of Dr. Percival.

Observations and Experiments of the Efficacy and Modus Operandi of Cupping Glasses in preventing and correcting the effects of poisoned wounds, by C. W. Pennock, M. D.

A Memoir concerning the Fascinating Faculty which has been ascribed to the Rattlesnake and other American Serpents, by B. S. Barton, M. D.

Rapport sur L'utilité des Paragréles.

Constitution and Laws of the Montreal Mechanics Institute. All presented by Isaac Hays, M. D.

North American Review, vols. 8, 9, and 10, and first part of vol. 11, new series, presented by George Fox, Esq.

First Lessons in Practical Geometry, by W. R. Johnson, presented by the author.

The corresponding secretary laid on the table the following works received in exchange for the Journal of the Institute.

The North American Review, for October, 1829.

The London Journal of Arts and Sciences, for October, 1829.

Gill's Technological and Microscopic Repository, for October, 1829.

Journal des Connaissances Usuelles et Pratiques, for August, 1829.

Journal Universal des Sciences Medicales, for July, 1829.

Bibliotheque Physico-economique, for August, 1829.

Recuil Industriel, for June and July, 1829.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, for July, 1829.

The discussion for the evening being called for, a paper was presented by Mr. Charles Potts, in reply to the query, "What is the proper method of computing the power of high pressure steam en-

gines?" which was received, when, on motion, the reading of it was deferred until the next meeting.

Extract from minutes.

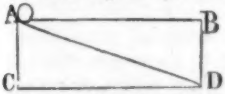
JOSEPH M. TRUMAN, *Chairman.*
WILLIAM HAMILTON, *Recording Secretary, pro tem.*

An examination of the question, 'Does a Body, Descending on an Inclined Plane, with an Accelerated Motion, press the Plane with the same force through every portion of its length?' Read at the meeting held October 22, 1829, *by* DAVID H. MASON, Machinist.

TO THE FRANKLIN INSTITUTE.

As there exists a diversity of opinion respecting the solution of the question, "does a body descending on an inclined plane with an accelerated motion, press the plane with the same force through every portion of its length," the following remarks may not be out of place.

It is believed that the following propositions need only be stated, and accompanied with diagrams, to be well understood by those who are acquainted with the laws of motion, and resolution of forces.



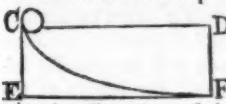
Proposition 1.—If a body, A, be acted upon by two forces, represented by and in the direction of the lines AB and AC, and those forces continue uniform in their motions, it will take the direction of the diagonal of those forces.

Proposition 2.—The body, A, acted upon by two forces, represented by and in the direction of the lines AB and AC, and those forces are equally accelerated, it will take the diagonal of those forces.

Proposition 3.—The body, A, acted upon by two forces, represented by and in the direction of the lines AB and AC, and those forces are equally retarded, it will take the direction of the diagonal.

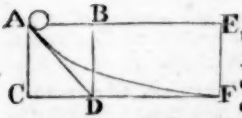
Proposition 4.—A body B, acted upon by two forces, represented by the lines BD and BC, the force BD accelerated, and the force BC retarded, it will take the direction of some curve, BE, as the parabola or cycloid.

Proposition 5.—When the body is at E, if it were propelled back again by the forces ED accelerated, and EC retarded, in the inverse ratios of the former proposition, it would retrace the curve EB.



Proposition 6.—A body, C, acted upon by two forces, represented by the lines CE and CD, both accelerated, CE in the ratio of 3, 5, 7, and CD in the ratio of 4, 8, 16, it would take the direction of the curve CF.

Proposition 7.—When the body is at F, if it were propelled back again by these forces, in their inverse ratios, it would retrace the curve FC.



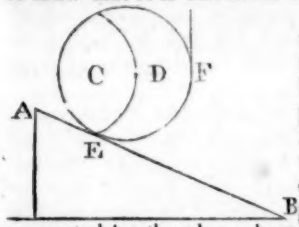
Proposition 8.—A body, A, acted upon by two uniform forces, represented by AB and AC, would take the direction of the diagonal of those forces, but let the force AB be accelerated and represented by AE, and the force AC as before, the body would be carried forward from the plane AD, and take the direction of the curve AF.

That velocity will counteract gravity, sir Isaac Newton avers in his Principia, Definition five.

"If a leaden ball, projected from the top of a mountain by the force of gunpowder with a given velocity, is carried in a curve line to the distance of two miles before it falls to the ground, the same, if the resistance of the air was took away, with a double or decuple velocity, would fly twice or ten times as far. And by increasing the velocity, we may at pleasure increase the distance to which it might be projected, and diminish the curvature of the line, which it might describe, till at last it should fall at the distance of 10, 30, or 90 degrees, or even might go quite round the whole earth before it falls, or lastly, so that it might never fall to the earth, but go forward into the celestial spaces, and proceed in its motion *in infinitum*."

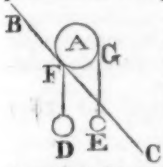
A body sufficiently heavy to break through ice, will cease to do so, if put in a quick progressive motion, which is frequently exemplified by persons skating.

It was judged proper thus far, to give the foregoing propositions of bodies acted upon by two forces, in order to ascertain which of these laws govern a body in descending an inclined plane, or rather, to show that it is dissimilar to either of these laws or propositions.



Let AB represent the plane, and CD the body that is to descend upon it, and that part designated by C, will be equally balanced and rest on the plane. Suppose the part C to be cut off, and the remaining part, D, to be sustained by two supports, one on the plane at E, the other by a cord, or otherwise, at F, the greater portion of the body, D, will be supported by the plane, because that end of the body is the largest, and because the support, E, is lower than the support, F. Thus it is evident that the amount of pressure on the plane will be made by the part C, and the larger portion of D. Now let the parts C and D be joined again, and the support taken from F, all that part of the body unsustained by the plane will fall by the force of gravity, but the plane intercepting opposes the direct gravitating force, constantly resolving it into two forces, one in the direction of gravity, the other in the direction of the plane, and these forces will be equally accelerated, because, when the body has moved half the length of the plane, it has descended half the height of the plane; when one has passed $\frac{2}{3}\frac{3}{4}$, &c. the other has descended $\frac{3}{3}\frac{3}{4}$, &c. Again, that part of the body which is unsustained, and opposed by the plane in its direct descent, will be a constant force added to the velocity, producing

the acceleration in the direction of the plane, the other part will be a constant force added to the velocity, producing the acceleration in the direction of the perpendicular, and these forces must be constant, for the accelerations are uniform, which has just been shown, and if the accelerations are uniform, and the forces are constant, then the pressure on the plane will be a constant uniform pressure.



Again, let BC represent the plane, and A the body that is to descend upon it. Suppose the body to have no gravity, but let the weight, D, be suspended at F, the point of contact on the plane, and the weight, E, at G, to represent the gravity of the body, and let the weight, D, represent that portion of the body sustained by the plane, now it is very clear that the weight, D, has no tendency to move the body forward, but only to press on the plane. All that can move the body is the weight E, which is a direct gravitating force, and would move the body in the direction of gravity; but the plane prevents that course, and compels it to move in the direction of the plane; the weight, E, will be accelerated in its descent, and the body accelerated in the direction of the plane, and these accelerations will be equal as before stated. The weight, D, will remain unaltered, except by its *inertia*, to give greater acceleration to the two forces, therefore "the pressure on the plane will be the same through every portion of its length."

It will be perceived that a body descending an inclined plane with an accelerated motion, is not analogous to proposition 2, because in that proposition the body is acted upon by two forces, and these are composed into one, in the direction of the diagonal of these forces, urging the body in that course, whereas, in the inclined plane, the body is acted upon by one force only, and that force resolved by the plane into two, the body taking the direction of one of these forces.

A body will not descend on a plane in the same time that it would descend in free space, because all that portion of the body that is sustained by the plane, has no tendency to fall, but must be carried along by the part that is unsustained.

It is a curious fact, that when a body is descending an inclined plane, the forces are equally accelerated, notwithstanding the friction of the plane or the resistance of the atmosphere, and it is presumed that a more perfect instance of equal accelerations cannot be found.

From the above, it will be seen that, in the communication on this subject in the September number of the Journal, correct conclusions were drawn from wrong premises.

Replies to certain questions submitted to the Monthly Meeting of the Franklin Institute. By CHARLES POTTS, *read October* 22, 1829.

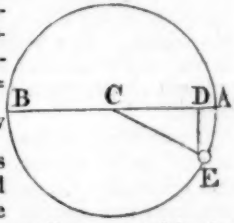
Reply to the question "What is the absolute centrifugal force of a body revolving in a circle of a given diameter, d, with a given velocity, v.

The periodic time of a body revolving in a circle, by means of its own gravity at the circumference of the earth, is ordinarily determined to be equal $C\sqrt{\frac{2R}{g}}$; where R is assumed equal the radius of the earth, $g = 16\frac{1}{2}$ feet, and $c = 3.14159$, &c.

As the correctness of this expression depends upon the accuracy with which the terms are assigned in the following theorem, viz. that the central force of a body moving in the periphery of a circle is as the square of the arc divided by the diameter; it may be of use to give the usual manner in which this theorem is demonstrated.

Thus, let the arc AE (Fig. 1,) be described by a body revolving in a circle in a given moment of time; then, from the nature of a circle (the arc AE being very small, and, consequently, nearly equal to its chord) $AE^2 = AB \times AD$, and, therefore, $AD = \frac{AE^2}{AB}$. Now AD is the space through which the body is drawn from the tangent in the given time; and though 2 AD is the proper measure of the central force, yet when the forces compared are all computed in the same manner, the ratio in both cases will still remain to be the same. Hence, if g (= the space through which a heavy body descends at the surface of the earth in one second of time,) be represented by AD, and AC be put equal R = the radius of the earth, then the space described by the body revolving at the circumference of the earth in one second of time, will be represented by $AE = \sqrt{AB \times AD} = \sqrt{2\,g\,R}$ and the circumference of the earth being $2\,C\,R$, we have the following analogy; as $\sqrt{2\,g\,R} : 2\,CR :: 1'' : C\sqrt{\frac{2R}{g}}$ = the time in which the body would pass around the entire circumference of the earth, as above stated.

Fig. 1.



I have adverted to the foregoing theorem because it might be urged that however near the arc AE may be supposed to approach to its chord, it can never be considered as absolutely equal to it; and hence the deductions for the centrifugal force which are predicated upon this supposition, as will be the case in the following remarks, are not such as the question demands: it may not, therefore, be amiss, if greater accuracy is required, to give the following series expressing the arc in terms of the diameter and versed sine, viz. putting $2R = D$; the arc.

$$AE = \left(1 + \frac{g}{2.3\,D} + \frac{3\,g^2}{2.4.5\,D^2} + \frac{3.5\,g^3}{2.4.6.7\,D^3} + \&c.\right)\sqrt{g\,D};$$

where the order of the series being evident may be continued at pleasure. This expression being substituted for the value of the arc or the space described by the body in one second of time, the periodic time may be found as in the preceding analogy. Having now the periodic time of a body revolving at the circumference of the earth, it follows, that as the central forces of two bodies moving in different peripheries are in a ratio compounded of the direct ratio of the diameters and the reciprocal one of the squares of the periodical times; if t be put for the time which the body requires to perform one revolution around the circle, the diameter of which is given $= d$; then, by the above law, the central forces of the two circles being denoted by F and f respectively, we have $F : f :: t^2 \times 2R : \left(c\sqrt{\frac{2R}{g}}\right)^2 \times d$ and consequently $f = \frac{C^2 d}{g\,t^2} \times F =$ the centrifugal force required. Or because the time $t = \frac{Cd}{v}$ we shall have in terms of F, d, g, and the given velocity, v. $f = \frac{v^2}{gd} \times F =$ the centrifugal force of the body, the weight of which, at the surface of the earth, is equal F.

The solution of this question being essential to the determination of many useful and interesting problems in mechanics, it may be useful to give an example of its application.

Let one of the balls of a governor of an engine weigh 30 pounds; and suppose that it revolves in a circle, the diameter of which is 3 feet, in one second of time.

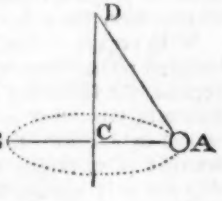
Here $F = 30$ $d = 3$ and $t = 1''$

Therefore $f = \frac{3 \times 30 \times \overline{3.14159}^2}{16\frac{1}{2}} = 55.177$ pounds, the centrifugal force of the ball.

If now it is required to find how long the arm of a governor must be in order that the above conditions may be fulfilled.

Let the length of the arm $AD = l$. Put $CD = a$ and $AB = d$ as before. Now it is known that CD : AC as the force of gravity on the body, is to the centrifugal force, that is, $a : \frac{1}{2}d :: F : \frac{C^2 d\,F}{g\,t^2}$ from whence results $a = \frac{g\,t^2}{2\,C^2} = .814$, &c. in the present case.

Fig. 2.



But $AD = l = \sqrt{AC^2 \times CD^2} = 1.7$ foot nearly the length of the arm required.

Again, suppose the arm AD of the governor to be $2\frac{1}{2}$ feet long, and the diameter of the circle in which the ball moves to be 3 feet, to find the time the ball occupies in moving round the periphery.

From the above equation, $a = \frac{g\,t^2}{2C^2}$ we have also $t = C\sqrt{\frac{2\,a}{g}} = 1.108\sqrt{a}$ = the periodic time of revolution.

Now, by the question CD = a = 2 feet.

Therefore $t = 1.108 \times \sqrt{2} = 1.108 \times 1.4142 = 1''.5669$, or one second and a half nearly.

It is obvious that if s be assumed to represent the ultimate centripetal force of a revolving body (the strength of the arms and rim of a fly wheel, for instance,) then by equating this with the general expression for the centrifugal force given above, we may determine the velocity with which a fly wheel (or the like) by the centrifugal force would be torn asunder. In a similar manner, also, it would be easy to assign the relative strength of the arms, &c. when at rest, and when revolving with a certain velocity.

Which will move down an inclined plane with the greatest velocity, a wheel of two, or one of four feet in diameter, supposing their weights the same and the matter of each to be all disposed around in its periphery?

It is evident from the given proportion of the two wheels, that the spaces described by them in passing over the same length of the plane will be equal: for let the length of the plane on which the two wheels are supposed to roll down, be assumed equal to the periphery of the largest wheel; then the space described by the larger wheel in descending this plane, will be equal to that of a cycloid, the base of which is equal to the length of the plane, and axis equal to the diameter of the wheel. The length of this cycloid, it is known, is equal to four times the diameter of the generating circle, therefore the space described by the larger wheel in descending the assumed plane will be equal to sixteen feet. Now as the peripheries of circles are to one another as their diameters, and the diameter of the lesser wheel is half that of the larger, by the question, the length of the plane will be twice the length of the peripheries of the smaller wheel. Hence it follows that the small wheel in passing down half the length of the assumed plane, will describe a space equal to four times its diameter; and in rolling down the whole length of the plane, it will describe a space equal to eight times its diameter, that is, equal to sixteen feet, the same as that of the larger wheel.

With regard to the relative forces of these two wheels down the inclined plane, upon which it is known that their respective times depend, the following may be taken as an evidence of an opinion which is somewhat prevalent in matters of this nature. It is observed in Jacobs' Observations on Wheel Carriages, "that in the draught of carriages ascending inclined planes, the moving power acts not only against the vis inertia, which is always equal to the absolute gravity of the load, but also against its relative gravity, which increases with the inclination of the plane; and with respect to carriages raised on wheels, it is to be observed, that the higher the axle is removed from the plane, the farther is the centre of

gravity removed out of the perpendicular line of support; so that the lower the wheel, the less is the relative gravity of the carriage. Hence it is inferred, that, supposing the friction of two carriages of equal weight, but of different sized wheels, to be equal, the low wheeled one would be drawn up hill, on a smooth plane, much more easily than the high wheeled one, though on a smooth horizontal plane, the latter would be drawn more easily than the former; on the contrary, in going down hill, the high wheeled carriage will be urged forward by its relative gravity more than the low wheeled one."

The fallacy of the above reasoning, applied either to carriages or to the *two wheels in question*, which are analogous, must be obvious, when it is recollected that the power, or relative force that urges a body down an inclined plane, is as the sine of the angle of the inclination of the plane, the weight of the body and the length of the plane being the same in both cases. Hence, when the angle of elevation is the same, as is the case in the present instance, the relative forces of the two bodies are equal. It is, therefore, concluded, that as the velocities of bodies uniformly accelerated are in the subduplicate ratio of the forces and spaces directly, and the weight of the bodies reciprocally, and as these have been shown to be equal, the velocity of the two wheels will be equal. It is hardly necessary to observe, that, in this investigation, the resistance to the two wheels in rolling down the plane has been supposed equal, and the force of gravity uniform.

Does a body descending on an inclined plane with an accelerated motion press the plane with the same force throughout every portion of its length?

In the Journal of this Institute for September last, is published a solution to this query.

The ingenious author of the solution therein demonstrates, by a brief resolution of the acting forces, the affirmative of the proposition.

The Editor of the Journal in controverting the solution, has advanced an opinion, which, if correct, must tend ultimately to overthrow Galileo and all his celebrated demonstrations relative to accelerated motion.

It has been observed, in the remarks of the Editor, after supposing the case of a ball fired from a gun, that "*a rapid motion* in the descending body resembles a *centrifugal* force, and operates in the same way in *counteracting the effect of gravity.*"

It is acknowledged by the Doctor in the previous part of his remarks, that "a body rolling down a plane has its motion *accelerated in the same ratio* as when *falling through free space:*" it will be proper, therefore, to inquire, as the uniformly accelerated motion of a body falling through free space, supposes the accelerating force to be *constant and uniform*, whether the ratio will still be the same, when the accessions of velocity to the body rolling down the inclined plane are supposed to counteract the effect of gravity, that is, whether the motion of the body down the plane will be *uniformly accelerated.*

Let the body be supposed to commence its motion from a state of

rest, and by the effect of gravity upon it, to roll down the inclined plane, the length of which is AB, and height BC.

Now the first impulse or effect of gravity to urge the body down the inclined plane, is $=\frac{BC}{AB} \times W$, where W represents the weight of the body. If, therefore, we can conceive that as the velocity of the body increases in rolling down the plane, the pressure or effect of gravity of the body downwards (which is equal to its weight W,) is counteracted or diminished, it must follow that all the succeeding impulses after the first are continually diminished, and hence it is obvious that the motion thus produced would not be *uniformly* accelerated.

It is proper to observe that in assigning the weight of the body, the limitation is here understood, that the effect of gravity is the same at all heights from the earth's centre. Was this not the case it might be "advantageous" to inquire, supposing the plane to extend to the utmost verge of the sphere of the earth's gravitation, and the body equal in weight to the moon, for instance, to commence its motion at this point, whether the pressure of this body on the plane as it approached the earth, would be nothing, or *less than nothing;* for it follows that if a rapid motion counteracts the effect of *uniform gravity*, every *increment* in the *variable* gravity must have its corresponding counteracting influence.

In considering the question with respect to the force of the descending body on the plane, in a *practical point of view*, it may appear plausible, that, although the force pressing the plane be constant throughout every portion of its length, according to theory, yet the *effect* of this pressure on the plane will not be the same. This paradoxical position may be illustrated in the following manner.

Mr. Buffon and others, in experimenting on timber with a view of ascertaining its relative strength, found that the deflection of beams equal in every respect as to size, texture, &c. increased with the times the weights were acting on them until they broke. Suppose now that an inclined plane had been formed by a series of these equal timbers, resting on props at both ends, and that a heavy body descended thereon with an accelerated motion, would the lower timbers be deflected or bent as much as the upper ones of the inclined plane? The answer must be obvious, if we can place confidence in the experiments above referred to. Here we might reason from effect to cause, and perhaps conclude as in the premised paradox; but it may be more "advantageous" first to ascertain how the fibres of a piece of timber, submitted to any stress, are effected during the time of its action.

In concluding these remarks, it is but justice to observe, that I have constantly borne in mind the sentiment contained in the same number of the Journal, under the article monthly meetings, viz. "error of opinion may be" advantageously "tolerated, whilst reason is left free to combat it," and have, therefore, that this good

end may be obtained, considered the position of the Doctor as having been seriously assumed.

CHARLES POTTS.

Philadelphia, October 22, 1829.

Remarks by the Editor.—The position taken by the Editor in his remarks in the September number, appended to the reply to the query last alluded to, was "seriously assumed;" it was, however, only the impression of the moment, the demonstration having been received and returned by mail the same evening. A little reflection rendered it evident that the conclusion drawn by the Editor was incorrect, yet he was still desirous that the discussion commenced should not be terminated by his immediately crying, "*Peccavi, et confiteor culpasmeas.*

The pressure which a body exerts upon an inclined plane, is certainly independent of the velocity of its motion, as the gravitating force is inherent in the body, and cannot, therefore, like momentum, be affected by velocity; rest, or motion, leaving it unchanged. This pressure has for its value the expression $g.\ cos.\ E$, where g is the entire force of gravity, and E the angle of elevation of the plane; or we may use this form, pressure $= \frac{\text{gravity} \times \text{base of plane}}{\text{length of plane}}$.

Were the body fired from a gun, in the direction of the plane, as supposed in our former remarks, it must be clear, upon the principles which we have admitted, that gravity would still tend to draw the body down from its rectilinear course, with a force which must remain unaffected. As the whole force of gravity during the time of descent is invariable, so certainly must that part of it be which is counteracted by the plane.

On the relation between Rolling and Dragging Friction. Read before the Franklin Institute, at the Monthly Meeting, October 22, 1829. *By* WALTER R. JOHNSON, Professor of Mechanics and Natural Philosophy in the Franklin Institute.

THE two kinds of friction referred to, may be illustrated by the motion of a cylinder, (Fig. 1.) moved over any plane surface by a force applied, first, opposite to its centre of gravity, and at *right angles* to its axis, and secondly, opposite to the same centre, but in the direction of its axis. The former force will, if both the cylinder and the plane be *perfectly smooth*, unyielding, and free from foreign matter, produce a progressive motion only in the cylinder. But in every practical case such an application of force produces likewise a rotation, and, in proportion as the roughness of the surfaces prevents or resists the sliding of one over the other, in the same proportion will the rotary sooner or later correspond to the progressive motion. We may easily conceive, however, that while a body is moving forward with accelerated velocity, that is, while its centre of gravity

advances with increasing rapidity, the revolution on its axis shall be uniform, and the motion of any point on the periphery may, at any given moment, be either greater or less than that of the centre of gravity. Should a cylinder, revolving under such circumstances, come to apply its periphery suddenly to a part of the plane, where, from the roughness of surface, it should be compelled to coincide in its revolving velocity with the motion of progression, it cannot be denied that while the two motions were coming to an equality, a portion of rubbing must take place, and the extent of surface rubbed must be equal to the difference of motion between the centre of gravity of the cylinder and the assumed point of the periphery. Thus, if while the centre traverses a straight line of four feet, the circumference revolved through five, *in the same direction*, then the extent actually rubbed over would be one foot. If it revolved in the opposite direction to that which friction would of itself produce, then we may conceive that each point of the plane passes over some one point of the cylinder, and, therefore, that there is from this cause a friction through four feet of space due to the progressive motion, and again, that each point of the cylinder rubs against some point of the plane, and produces a friction through five feet due to the rotation, and consequently, that the united effects of these opposite motions would be to change the existing rotary motion into one in the opposite direction, by a quantity equal to a direct friction through *nine* feet; that is, through the sum of the two motions. To illustrate the preceding remarks, we may easily suppose a wheel or cylinder to receive a sudden percussion, which shall cause a rapid progressive motion commencing from a state of rest; this motion may generate a degree of rotary motion which may or may not be equal to the progressive velocity, according to the nature of the surface over which it moves. If, after a short time, the surface of the rolling body ceases to touch the plane surface and traverses free space, the rotary motion will continue nearly uniform, while the progressive motion may be greatly retarded, or may entirely cease. If in this case the body comes again in contact with the plane, the uniform rotary motion will generate a friction, which will increase the rectilinear motion, by communicating to the centre of gravity part of that force which had been employed in producing rotation. The case now supposed is precisely that which is seen in balistics, when a cannon ball, after having received, by traversing the gun, a rotary motion, and subsequently nearly expended its force in overcoming the resistance of the air, is seen to acquire an additional velocity by coming in contact with the ground. A similar transfer of motion from the rotary to the rectilinear direction, through the interference of friction, is seen, when a billiard ball is caused to retrograde on the table, by giving it an oblique stroke downwards in a direction which passes below the centre of gravity. Another example to the same effect is that of a ball falling from a tower at the same time that it revolves on some axis of its own. When it comes to the ground the rotary is converted into a rectilinear motion by the agency of friction, and the ball rolls off horizontally from the spot where it first struck.

A still more remarkable illustration of rolling friction is presented in the common rolling mill, for converting metals into plates, where it puts in motion not only the bar of metal rolled, but often one of the rollers also, notwithstanding all the friction of its axle.

From what has now been offered, we may conclude that the idea sometimes held out, *that a body rolling along a surface causes no friction*, is not well founded in any physical case where a force is employed to generate rectilinear motion; and can only be true when the motion of rotation *already produced* is precisely correspondent to that of progression. Still the obstruction opposed to progressive motion, by a roller on a plane, is extremely small, and in most practical cases where rollers move on smooth planes, is actually regarded as nothing.

It is not, however, with respect to a rolling friction of this sort that the subject possesses the most practical interest. If the cylinder before supposed were to be moved along a plane by a force applied in the direction GP of its length, (Fig. 1,) and passing through the centre of gravity, G, it would generate a real *dragging friction.*

Fig. 2.

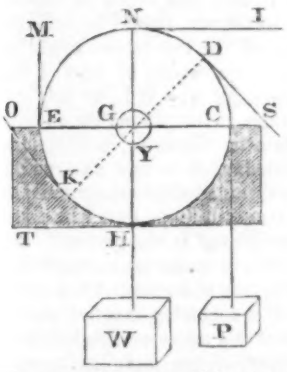
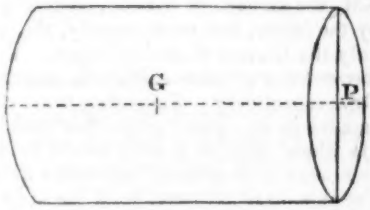


Fig. 1.



The same thing would be true if the solid were laid in a semi-cylindrical groove or hollow (Fig. 2,) and caused to revolve about its axis, its surface being in contact with the concave part of its bed, and pressing it with a force due to the weight of the cylinder. The force, then, which would be necessary to cause this body to revolve, would be equal to that which would be required to drag the cylinder lengthwise along the plane. Every revolution of the cylinder must, therefore, produce the same amount of friction as if its surface were reduced to a parallelogram, and the body were dragged without revolving through its breadth over a plane surface. Such would be the case, if the forces applied to the cylinder to produce rotation were directed in such a manner as neither to increase nor diminish the effect of gravity.

But if a weight were applied as represented at P, (Fig. 2,) it is

obvious that its own gravity would increase the pressure at H, and, consequently, augment the friction caused by the cylinder, so that after allowing for the friction caused by W, (which is here intended to represent the weight of the cylinder,) we must make an additional allowance for P itself, according to the nature of the materials of which the cylinder and the bed, EHC, are composed; this allowance would again cause a new pressure and friction, and thus a decreasing geometrical series of weights must be added at the point C, having for the first term such a part of W as is expressed by the relation of pressure to friction, in the case of the given materials, and for a common ratio of the progression, the fraction expressing the same relation. The sum of all the terms, continued to *zero*, will be the actual amount of P at the moment when motion commences. The sum of all the terms *following the first*, will be found by *multiplying together the first and second terms of the series*, and *dividing the product by their difference. The quotient added to the first term gives the sum of the series required.* The applicability of a similar method of computation to the friction on the gudgeons of water wheels, moved by the gravity of water, is too obvious to require demonstration.

If instead of applying a weight at P only, we should apply two equal forces, one in the direction of CP, and the other in that of EM, the amount of friction, caused by the former, would be relieved by the latter, and consequently, the sum of the two forces would be only the friction of the cylinder. The same would be true if the forces were to take either the directions NI and HT, or KO and DS, respectively. Supposing the cylinder to be placed on an axis smaller in any given proportion than its own diameter, as GY, then the whole effect of gravity would be transferred to this axis, and if this were to be caused to revolve by a force applied tangentially to the axis itself, it must be of the same magnitude as that which had before been applied to the cylinder when placed in the groove. But if applied to the exterior of the cylinder, it must be as much less than before, as the diameter of the axis is less than that of the cylinder. In other words, the difficulty of overcoming friction at the axle, is to that of overcoming the same at the outer periphery, when confined in a bearing, as the diameter of the axle is to that of the cylinder. If D be the diameter of the cylinder, d of the axle, and F the relation of weight to friction, we shall have the proportion

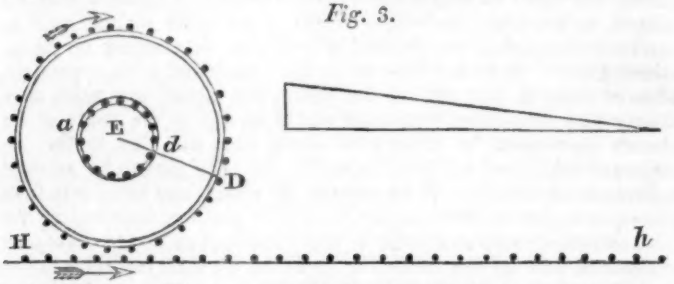
$$D : d :: F : \frac{dF}{D} = \text{the force required to overcome the friction on the axle.}$$

It will strike those who consult authorities on this subject, that writers of much credit differ among themselves as to the manner in which this resistance is to be represented. In the article on this subject in Rees' Cyclopedia, we read that "the friction which the wheel would have against its supporting plane, if it did not turn round its axis, is by its turning round, transferred almost wholly to the axis and nave, whose circular motion is, notwithstanding, so much slower. It is, indeed, notorious, that the great friction of the wheels of carriages lies between the axle and naves, and how then can it be properly asserted that such friction is diminished at the axle as the velocity of the cir-

cular motion is there diminished? Accordingly, it has been alleged by a late writer that friction is not diminished by the use of wheels, but merely transferred from the outer surface of the wheels to its nave and axle, and that in the case of a wheel rolling on the ground, the spokes act only as single levers to overcome the friction of the periphery."

This appears to be little more than a quibbling about terms, since, whether we choose to assert that the friction is diminished because the axle moves slowly in the box, and its moment is thereby diminished, or to say that the resistance of friction is overcome by the power of the lever, the two arms of which are the radii of the wheel and axle respectively, we do but express one and the same thing—proceeding from one and the same cause, namely, the diminution of the size of the axle. This will be illustrated by Fig. 3, where the

Fig. 3.



horizontal plane H*h*, is represented as furnished at equal distances, with small balls or prominences so attached to its surface as to present equal obstructions to the dragging of heavy bodies along that surface.

The exterior of the wheel, ED, is likewise represented as furnished with equal prominences at equal distances. When, therefore, the wheel is compelled to make one revolution without advancing, as many prominences would be broken from its periphery as would be dislodged from the plane surface while it advanced, without revolving through a space equal to its circumference. But when the wheel is allowed both to revolve and to advance in such a manner as to apply its periphery to a length of plane just equal to the space traversed by the centre, the prominences will be geared together like the teeth of a rack and pinion. But in the latter case the prominences may all remain unbroken. But when the wheel rests with its whole weight on an axle, as *ad*, the number of prominences which can be disposed at the same distances as before, on the circumference of the axle, will be diminished, in proportion as the radius E*d* of the axle is smaller than ED, that of the wheel.

Some persons have maintained, that when a cylinder merely rolls along a surface, without being attached to an axis, there is, in reality, no friction, and that the whole question about rolling and dragging friction, is, therefore, futile. It is true that when a wheel or cylinder rolls on a surface as nearly *plane* as it is possible for art to

produce, the amount of friction, being no more than is due to the moment of inertia, is extremely small, compared with that of dragging, but the observations already made, and the examples cited, will be sufficient to show that the actual advancement tends, by a force equal to that which produces the rotation, to break down the prominences of the surface, for if we consider the cylinder rolled forward by a fine thread unrolled from its upper side, we may consider also the plane beneath to oppose a force tending to draw it in the opposite direction, and this force is friction. I would here notice an error which appears to me to have been made by Wood in computing the friction of his carriages, in No. 10 of his experiments, (Wood on rail-ways, pages 190, 194,) where the wheels, carriages, and loads descended by their gravity. He has added the weight of the wheels and axles to that of the carriages and loads, and, when comparing the sums to determine whether friction increased with the weight, he has taken the whole weight in the same manner as if he had been computing the friction of a sledge descending on an inclined plane. If he had first taken the wheels and axles separately, allowed them to descend on the plane, and noted how much more slowly they descended than what would be due to the angle of the plane's inclination, he might have found what was due to the carriage and load, and which is, in truth, the only part to be ascribed to *pressure on the axles*. If we suppose the wheels and axles only to be placed on a plane so little inclined as just to continue their rolling motion, and afterwards on another so much inclined as just to cause a car to descend with all the friction of its axles, we shall readily conceive that, in the latter case, the wheels will descend with a constantly accelerated motion, and might, therefore, overcome a certain portion of the resistance of the carriage. If, then, the wheels serve the purpose of dragging the load downwards against the resistance of friction, it is certainly improper to suppose them part of the retarding cause, and to compute their effect as such. The wheels and axles used by Wood weighed 11 cwt., which, on a plane inclined by an elevation $\frac{1}{104}$ parts of its length, would, doubtless, if disincumbered of their cars, have acquired a velocity far greater than that which his experiments actually gave to the cars.

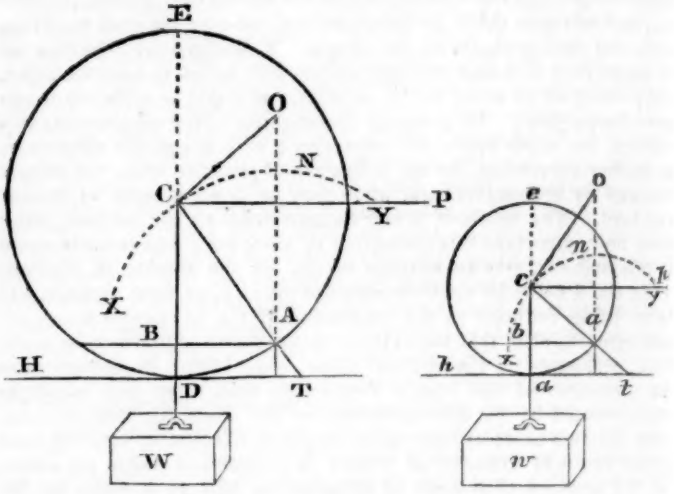
Thus, in every case where we would compute the effect of friction by comparing the actual distance passed over by a carriage, with the theoretical descent as caused by the inclination of the plane, we must consider the weight of the car and load as the cause of friction on the axle, and the gravitating power of the wheels as aiding to overcome the friction occasioned by the load. His formula, therefore, $F = G - \frac{WS}{rl^2}$ must be modified in such a manner as to allow for the influence of the wheels and axles in dragging the load down. It is not enough to subtract the weight of the wheels in each case from the total weight of the car and wheels. We must actually compute the separate influence of the latter, and add it to the amount of the friction observed to take place in the combined machine. The wheels must be regarded as a weight attached to a cord and hanging

over a pulley at the lower end of the plane. This would present the formula under the following aspect, where a is the amount of retardation suffered by the wheels when attached to the car, *more than when* they roll down resisted by no other friction than that at their peripheries. $F = G - \frac{WS}{rl^2} + a$. The quantity of resistance at the peripheries will, it is true, vary with the pressures, and the only mode of determining the law of this variation would be to suspend, successively, on the *axis* of the wheels, (which I suppose to be fastened in the naves,) by their centres of gravity, heavy cylinders of different weight, equal to the loads which the wheels would sustain in their car, and to cause those cylinders to descend over the road revolving with, and resting wholly on, the wheels. This might easily be effected by employing cast-iron carriage wheels with which to load the axles, and putting on so many to the same axle as might be sufficient to answer the purpose. By a careful investigation of the subject after this manner, we might apply the correction a with the proper allowance, or farther correction, for the difference of pressure when the wheels descend by themselves, and when they go down pressed by the car and load. The result of Wood's experiments on the inclined plane show how important this correction is, since his 5 experiments made in this manner, give an average of $\frac{1}{212}$ for the amount of friction, while the 8 made by the dynamometer give $\frac{1}{159}$ as their average, the latter being reduced to the conditions of the horizontal plane. I may remark, also, that the axles of those wheels with which he made his experiments on the inclined plane, were larger in proportion to the diameters of the wheels themselves than those with which he experimented by the dynamometer; so that when we come to consider the two cases as reduced to dragging friction, by dividing each by the ratios of diameter of wheels to diameter of axles, we obtain for the average of one set of experiments 16.1 to 1, while for the other we have 18.2 : 1, to express the relation between the weight and the friction of metal rubbing on metal. Thus a portion of between *twelve* and *thirteen per cent.* of the friction, which would have been manifest on the horizontal plane, was overcome and rendered imperceptible by the gravitating force of the wheels and axles. I would observe, in passing, that when we experiment on friction by means of inclined planes, we must consider that the relative pressure only of the body on the plane is to be compared with the force which tends to make it slide; but when we make use of the horizontal plane, we must regard the whole force of gravity as acting to produce friction. The small triangle, (Fig. 3,) will serve to express by its base and perpendicular the relation between relative pressure and friction when a body moves down the hypotheneuse.

I have already noticed some inaccuracies in the books which treat on this subject. It appears to me that in speaking of the advantage of a wheel in surmounting a fixed obstacle, there has been a similar mistake, and the erroneous statements made in consequence might lead some persons to place a wrong estimate on the carriage wheel, as well as on the nature of its friction.

It is laid down by Playfair, (Outlines of Natural Philosophy, page 103, vol. 1,) and cited in a note by Dr. Bigelow, (Elements of Technology, page 196,) that "the plane on which a carriage moves and the line of draught, being both horizontal, the advantage for surmounting an immoveable obstacle of a given height is as the square root of the radius of the wheel." I think it will appear, from what follows, that this supposition is erroneous, in cases where the wheel is to mount directly over the obstacle without rolling up an inclined plane to attain its elevation. Let Fig. 4 represent two wheels of

Fig. 4.



different heights, intended to surmount the equal obstacles TA and *ta*. Let the weights W and *w* be the same for both wheels, and the powers P and *p* be such as to produce an equilibrium in the wheels DAE and *dae* respectively. Then by a well known law in mechanics, when three forces are in equilibrium, each is represented by the *sine of the angle comprehended between the directions of the other two*. As the direction of gravity and that of the horizontal line of traction are at right angles to each other, the sine of the angle comprehended between their directions is equal to *radius*, and is, therefore, represented by CA or *ca*. Again, the horizontal force is represented by the sine of the angle BCA or *bca*, which is the line BA or *ba*, while the vertical force or gravitating power of W is represented in the two cases by the sines of BAC and *bac* respectively, which are the lines BC and *bc*. These two forces multiplied respectively by the distance at which they act, in a perpendicular direction from the point A or *a*, about which the wheel must revolve, in order to surmount the obstacle, ought to give equal moments to those of W mul-

tiplied by BA and *ba*. Hence $BA \times W = BC \times P$, or $P = \frac{BA \times W}{BC}$ and $ba \times W = bc \times p$, or $p = \frac{ba \times W}{bc}$. In order, therefore, to know the absolute values of P and p, we must determine the actual lengths of BA and BC, of *ba* and *bc*. BC is easily found by subtracting the perpendicular height of the obstacle from the radius, and BA is found by subtracting the square of BC from that of AC, and extracting the square root of the remainder. Thus $\overline{CA}^2 - \overline{BC}^2 = \overline{BA}^2$. But $BC = CA - BD$, therefore $\overline{BC}^2 = \overline{CA}^2 - 2\,CA \times BD + \overline{BD}^2$. Substituting this value of $\overline{BC}^2$ in the equation $\overline{CA}^2 - \overline{BC}^2 = \overline{BA}^2$, we have $\overline{CA}^2 - \overline{CA}^2 + 2\,CA \times BD - \overline{BD}^2 = \overline{BA}^2$, or $2\,CA \times BD - \overline{BD}^2 = \overline{BA}^2$; hence $BA = \sqrt{2\,CA \times BD - \overline{BD}^2}$. The value of P, therefore, must be $\frac{W \times \sqrt{2\,CA \times BD - \overline{BD}^2}}{BC \text{ or } (CA - BD)}$ which is now expressed in terms of the radius and versed sine. Substituting R for the radius of the larger wheel and r for that of the smaller, as also h for the perpendicular height of the obstacle, the above expression of the value of P becomes $\frac{W \times \sqrt{2\,R\,h - h^2}}{R - h}$, and by a course of reasoning precisely similar, we obtain $p = \frac{W \times \sqrt{2\,r\,h - h^2}}{r - h}$. Hence $P : p :: \frac{W \times \sqrt{2\,R\,h - h^2}}{R - h} : \frac{W \times \sqrt{2\,r\,h - h^2}}{r - h}$, and as both terms of this ratio are multiplied by the quantity W, supposed to be constant, we obtain $P : p : \frac{\sqrt{2\,R\,h - h^2}}{R - h} : \frac{\sqrt{2\,r\,h - h^2}}{r - h}$. But the expression of Playfair would be $P : p :: \frac{\sqrt{2\,h}}{\sqrt{R}} : \frac{\sqrt{2\,h}}{\sqrt{r}}$. This can only be true when the wheel, instead of surmounting the obstacle directly, rolls up an inclined plane to effect that purpose parallel to the chord AD, (not represented in the figure) and of a length proportional to it, or when h becomes infinitely small with respect to R or r. The expression $\sqrt{2\,R\,h - h^2}$ is equal to BA and $2\,R\,h - h^2 = BA^2$ as above stated. Transposing h^2 in this equation, we obtain

$$\left.\begin{aligned} BA^2 + h^2 &= 2\,R\,h = AD^2 \\ ba^2 + h^2 &= 2\,rh = ad^2 \end{aligned}\right\} \text{ hence } \overline{AD^2} : \overline{ad^2} :: 2\,R\,h : 2\,rh, \text{ or } \overline{AD^2} : \overline{ad^2} :: R : r \text{ and } AD : ad : \sqrt{R} : \sqrt{r}.$$

If then it be true that the advantage of a wheel, in surmounting a given obstacle, is directly proportional to the length of the chord drawn from the lowest point of its periphery to the top of the obstacle, we may grant that the proposition in question is true also. But as before shown, $P : p : \frac{\sqrt{2\,R\,h - h^2}}{R - h} : \frac{\sqrt{2\,rh - h^2}}{r - h}$, or, as the sine of the angle DCA divided

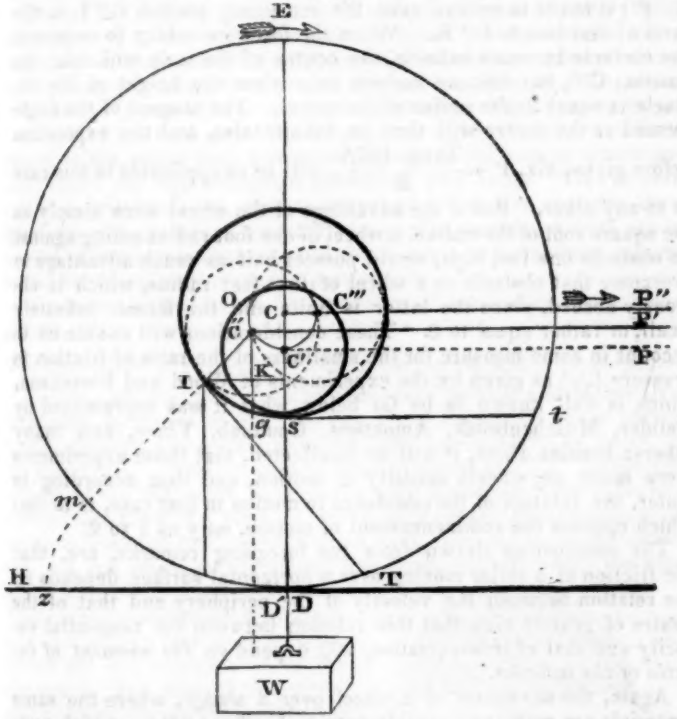
by the cosine of the same angle. And since the relation of sine to cosine is the same as that of tangent to radius, we may substitute the proportion $P : p :: \frac{\text{Tang. DCA}}{R} : \frac{\text{Tang. } dca}{r}$. We may be assured that this statement is true, when we consider that the centre of gravity of the wheel where we suppose the force P or *p*, to be applied must describe the curve CNY or *cny*, and that it must commence its motion in the direction CO or *co*, Fig. 4, and that the greatest effort will be required when the centre is at C and *c* respectively. But the tangent CO, which expresses the length of the inclined plane which the weight begins to surmount, is of the same magnitude as the tangent DT of the angle DCA, and the successive planes will be more nearly coincident with the horizontal line. Having, on the foregoing principles, determined the effect of obstacles which oppose the rolling of a wheel, we may proceed to consider the influence of that resistance on the quantity of friction at the axle. And here again I must remark, that some indistinctness seems to pervade the minds of *theoretical*, and often a total misapprehension of the subject, those of *practical* mechanics.

Bossut tells us that "rolling and dragging friction are combined at the axis of a wheel, and that there thus results a sort of *mixed friction*, because every point of the axis of the wheel describes a straight line (since it has not a rotation) equal and parallel to that which the periphery would describe if it were to slide on the ground, while, at the same time, every point of the box must, in succession, apply itself to some point of the axle." But if we consider that the wheel of a carriage is, in respect to its friction, under precisely the same conditions as the mechanical power called a *wheel and axle*, and that the mere circumstance of the motion of transportation cannot affect the nature of the friction on the axle, we shall be led to infer that this statement of the eminent French philosopher is not well founded.

As carriage wheels are ordinarily constructed, and as roads, and especially rail-roads, are commonly made, the resistance of obstacles at the circumference is much more easily overcome than that of friction at the nave. Thus in Fig. 5, where the wheel *m*DTE turns on its axle, *as* O, the line or spoke *s*D becomes the proper representative of a suspended lever, impelled at the upper end in the direction of PC′ by the resistance of friction at *s*, and at the lower by the resistance of opposing obstacles, (the amount of whose resistance I have just stated,) in the direction DH. It generally happens, however, that, except on very rough roads, the resistance from the latter cause, is less than that from the former. Hence, the wheel commences its forward motion sooner than the axle begins to slide in the box; so that its sliding motion is not (except in cases of great resistance at the periphery,) in the direction of the tangent *st*, but in that of some other line at IT. The axle then, ought to be found bearing not on the bottom, but on a part *back of the lowest line of the cylinder*. Having been led to this conclusion from the theory which I have now developed, I was induced to inquire of several wheelwrights, coach-

makers, carriage-smiths, and keepers of livery stables, whether they had ever noticed the fact, or whether they supposed it to be true, that the axle *did* rest in its box, elsewhere than on its lowest part; all, after a moment's reflection, answered, that as a force was applied to draw it forward, it must press and be most worn against its front and lower side; but upon examining the old axles in their possession, they have uniformly found my statement to be confirmed by testimony which they could not doubt. In moving a carriage, then, the animal exerts his strength to bring the axle into such a position that it will descend by the gravity of the load along an inclined plane

Fig. 5.



as if to follow some direction, as IT. If the axle be smaller than the box, so as to leave considerable space between them, the centre may retreat from the vertical C′D, ascending at the same time from C′ to C″, where it exercises a gravitating force due to the weight, and in the direction C″ D′, acting of course on the arm of the lever equal in length to D′, D. and which would, if the force P were relaxed, cause the wheel to retreat and again depress the point *m* towards *z*, describing the portion *mz* of a cycloidal curve. This effect is often observed to take place, but most persons are entirely unable

to account, on the popular supposition of the *forward bearing* of the axles, for this movement of the load. This position of the axle likewise accounts for the *retrograde rotation* of a wheel which is sometimes observed to take place through a portion of a revolution, when a heavy load first passes from rough ground to smooth ice. The gravitating force, when the centre takes the position C″, may be resolved into C″ I, perpendicular to the side of the box, and the inclined tangent I*g*, then the force which presses the surface, causes the friction, and opposes motion, is less than when it lies on the horizontal plane *st*, and the friction is diminished in proportion as C″ I is less than C″ *g*. Again, as the force P *now* acts in the direction C″ P′, it tends to relieve even the remaining portion C″ I, in the ratio of that line to C″ K. When the force necessary to surmount the obstacle becomes infinite, the centre of the axle will take the position C‴, but this can happen only when the height of the obstacle is equal to the radius of the wheel. The tangent of the angle formed at the centre will then be infinite also, and the expression before given, viz. $P = \frac{\text{Tang. DCA}}{R}$, will be as applicable to this case as to any other. But if the advantage of the wheel were simply as the square root of the radius, a wheel of one foot radius acting against an obstacle one foot high, would possess half as much advantage to overcome that obstacle as a wheel of four feet radius, which is obviously absurd, since the latter is finite and the former infinitely small, or rather equal to 0. These considerations will enable us to account in some measure for the smallness of the ratio of friction to pressure ($\frac{1}{17}$) as given by the experiments of Wood and Stevenson, which is well known to be far below what it was represented by Belidor, Muschenbroëk, Amontons, Coulomb, Vince, and many others; besides which, it will be recollected, that those experiments were made on wheels actually in motion, and that according to Euler, the relation of the resistance to motion in that case, is to that which opposes the commencement of motion, only as 1 to 2.

The conclusions drawn from the foregoing remarks, are, that the friction of a roller moving over a horizontal surface depends on the relation between the velocity of the periphery and that of the centre of gravity also, that this relation between the tangential velocity and that of transportation, will depend on *the moment of inertia of the cylinder.*

Again, the advantage of a wheel over a sledge, where the same materials are employed to slide over each other as those which compose the box and axle, is *as the diameter of the wheel to that of the axle.*

If friction wheels be employed, the ratio just stated must be multiplied by the relation between their diameter and that of their axles.

The amount of friction at the axle to be overcome by the moving force, will be proportional to the weight of the load, but will depend also on the obstacles which oppose the progressive rotation, and will attain its *maximum* when the height of the obstacle is equal to the

radius of the wheel, at which moment the advantage of the wheel to surmount the obstacle is a *minimum* or *zero*.

The advantage of a wheel to overcome any obstacle of a given height when the plane over which the wheel moves, and the line of draught, are both horizontal, will be *as the tangent of the angle formed by a vertical drawn from the centre of the wheel downwards, and another line drawn from the same point, to the top of the obstacle, divided by the radius of the wheel.*

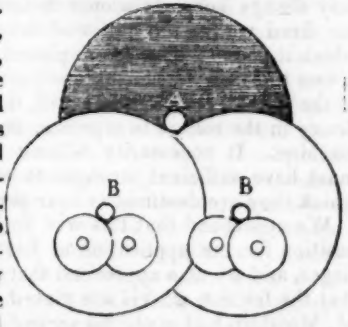
Modern Antiques. *By the* Editor.

Under this title we propose to furnish, occasionally, some palpable evidences of the forestalling disposition of our remote ancestors, who have, in numerous instances, deprived us, and our cotemporaries, of the honour of being the *true and original inventors, or discoverers,* of various improvements in mechanics, and other useful arts; and who even peep from their graves to dispute the rights of those who have issued to the world their new born projects in the form of letters patent, under the sign manual of presidents and kings. This is certainly a grievous case, and, unfortunately, not less common than grievous, and one which scarcely admits of a remedy; a deaf ear is turned to our remonstrances, and there seems to be nothing left to us but to appeal to "impartial posterity."

We have selected as the first evidence of the justice of our complaints,

The application of Friction Wheels to Carriages, and other purposes.

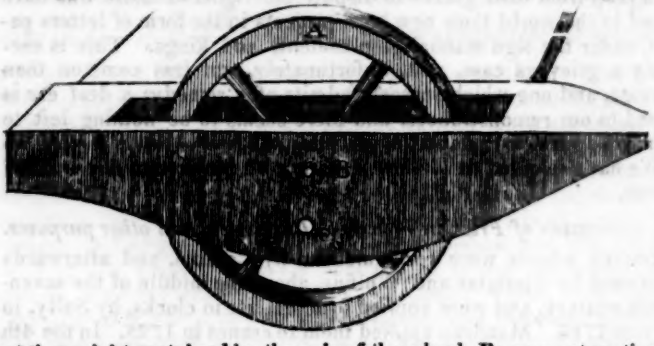
Friction wheels were recommended by Casatus, and afterwards mentioned by Stermius and Wolfius, about the middle of the seventeenth century, and were applied to actual use in clocks, by Sully, in the year 1716. Mondran applied them to cranes in 1725. In the 4th volume of the Machines Approuvées par l'Academie Royale, for the above year, there is a plate of Mondran's crane; the portion of it which is intended to diminish friction, is represented in the subjoined cut. A is a wheel on the axis of the drum, around which the rope winds which is to sustain the load. This wheel is surrounded by cogs, and turned by a pinion, or lantern, which are not represented in the drawing. The axis of this wheel and drum rest upon the peripheries of the friction wheels, B, B, and these again upon the smaller friction wheels shown in the drawing. M. Mondran does not pretend to be the inventor of the friction rollers, but merely proposes to apply to cranes a contrivance before known. He says, "the beneficial effect of this invention has been experienced in many machines to



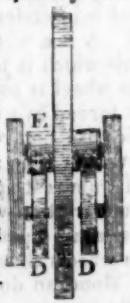
which it has been applied. We find in the Memoirs of the Royal Society of Berlin, published in 1710, a similar mode of preventing friction applied to pumps, since which time it has been used in clocks, and other machines, with perfect success."

"This manner of removing friction is not, perhaps, admissible in all cases, and particularly in machines intended for raising great weights, because the axis of the upper wheels acting directly downwards, must necessarily have a tendency to separate the friction wheels; the machine, nevertheless, is calculated to be *extensively* useful."

The next article in the same work, and under the same date, is a proposition by M. Mondran, to apply friction wheels to carriages. "This method," he observes, "of diminishing friction, consists in supporting the axis of a wheel upon two rollers only, instead of upon the four employed in the preceding method. A, is one of the wheels of a carriage, running in a suitable frame, there being a similar wheel on the opposite side; in each of the frames friction wheels are so placed,



that the weight sustained by the axis of the wheel, B, may act vertically upon the axis of the rollers, C. This is shown more plainly in the profile, where the axle tree, E, is seen resting upon the two rollers, D, D; and in order that each axle may always keep its proper bearing, two trunnions are fixed within the edges of the openings through which it passes; they are so placed as by their lateral action to cause the weight to act vertically on the axis of the rollers, D D. There will, therefore, be no tendency in the rollers to separate, as in the preceding machine. It necessarily follows that these rollers must have sufficient strength to sustain the weight which they are destined to bear perpendicularly."



We apprehend that this was actually the first proposition for the application of friction wheels to carriages, and we also apprehend that the mechanician has already seen that the friction wheels are placed upon the wrong side of the axle. M. Mondran had made his second machine upon paper, without adverting to the fact that, in the carriage, the load must press the axis

in a direction the reverse of that of the crane. All that is necessary, therefore, to make the description correct, is, to invert the figures; we did not feel ourselves at liberty to do so in our copy, particularly as it appears to us that the mistake of M. Mondran tends to show the originality of the proposition.

We cannot see the difference between the friction rollers above proposed, and those recently claimed as novelties by certain patentees.

Zoological Weather Glass.

At Schwitzengen, in the post-house, we witnessed for the first time what we have since seen frequently, an amusing application of zoological knowledge, for the purpose of prognosticating the weather. Two frogs, of the species *Rana arborea* (tree frog,) are kept in a glass jar about eighteen inches in height and six inches in diameter, with the depth of three or four inches of water at the bottom, and a small ladder reaching to the top of the jar. On the approach of dry weather, the frogs mount the ladder, but when wet weather is expected, they descend into the water. These animals are of a bright green, and in their wild state here, climb the trees in search of insects, and make a peculiar singing noise before rain. In the jar they get no other food than now and then a fly, one of which, we were assured, would serve a frog for a week, though it will eat from six to twelve in a day if it can get them. In catching the flies put alive into the jars, the frogs display great adroitness.

[*Mag. of Nat. History*, iv. 479.

Extraordinary effects of an Earthquake at Lima, in 1828. *Communicated by* Captain Bagnold.

Dear Sir,—Having experienced, during my residence at Coquimbo, on the coast of Chili, no less than sixty-one smart shocks of earthquake in twelve months, without taking minor ones into consideration, I was induced to obtain, from an officer of H. M. S. Volage, the particulars of the destructive visitation which occurred at Lima in 1828. As one of the effects produced appears to me worthy of record, I transmit it to you for a place in the Journal.

On the 30th of March, H. M. S. Volage was lying moored with two chain cables in the bay of Callao; the weather was remarkably fine and clear, when, at half past seven o'clock, a light cloud passed over the ship—at which moment the noise usually attendant on earthquakes in that country, resembling heavy distant thunder, was heard; the ship was violently agitated; and, to use the words of my informant, "*felt* as *if placed on trucks, and dragged rapidly* over a pavement of *loose stones*." The water around "hissed as if hot iron was immersed in it;" immense quantities of air-bubbles rose to the surface, the gas from which was offensive, resembling, to use my friend's phraseology again, "rotten pond mud;" numbers of fish came up

dead along side; the sea, before calm and clear, was now strongly agitated and turbid; and the ship rolled about two streaks, say fourteen inches, each way. A cry of "there goes the town," called my friend's attention towards it: a cloud of dust, raised by the agitation of the earth and the fall of the houses, covered the town from view, whilst the tower of the garrison chapel, the only object visible above the dust, rocked for a few seconds, and then fell through the roof; and, from the high perpendicular rock at the north end of the island of St. Lorenzo, a slab, supposed thirty feet thick, separated from the top to the bottom of the cliff, and fell with a tremendous noise into the sea. The wharf, or pier, was cracked three parts across, showing a chasm of eighteen inches wide; the chronometers on shore, except those in the pocket, and most of the clocks, stopped, whilst the rates of chronometers afloat, were, in many instances, altered. A great number of lives were lost; amongst whom were four priests, killed in the churches, one of them by the falling of an image, at whose base he was at prayer.

The Volage's chain cables were lying on a soft muddy bottom in thirty-six feet water; and, on heaving up the best bower anchor to examine it, the cable thereof was found to have been strongly acted on, at thirteen fathoms from the anchor and twenty-five from the ship. On washing the mud from it, the links, which are made of the best cylinder wrought iron, about two inches in diameter, appeared to have undergone *partial fusion* for a considerable extent. The metal seemed run out in grooves of three or four inches long and three-eighths of an inch diameter, and had formed (in some cases, at the ends of these grooves, and, in others, at the middle of them) small spherical lumps, or nodules, which, upon scrubbing the cable to cleanse it, fell on the deck. The other cable was not injured, nor did my friend hear of any similar occurrence amongst the numerous vessels then lying in the bay. The part of the chain so injured was condemned, on the vessel's being paid off at Portsmouth, and is now in the sail-field of the dock yard; and I should think a link of it would be worth preserving in the museums of the different scientific bodies.

That the phenomena of earthquakes are produced by volcanic explosion, there can be little doubt; and that they are frequently accompanied by powerful electric action, has long been known: to which of these causes are we to look for the powerful effects here witnessed?

I remain yours, faithfully,

THOS. BAGNOLD.

Knightsbridge, June 14, 1829.

Preparation of Sugar from Starch.

M. WIENRICH, says, that from one to two parts of sulphuric acid for each 100 parts of potato starch, is sufficient, if the heat applied be a few degrees above 212° F; and also that then two or three hours are sufficient to give crystallizable sugar. He applies the heat in wooden vessels, by means of steam.